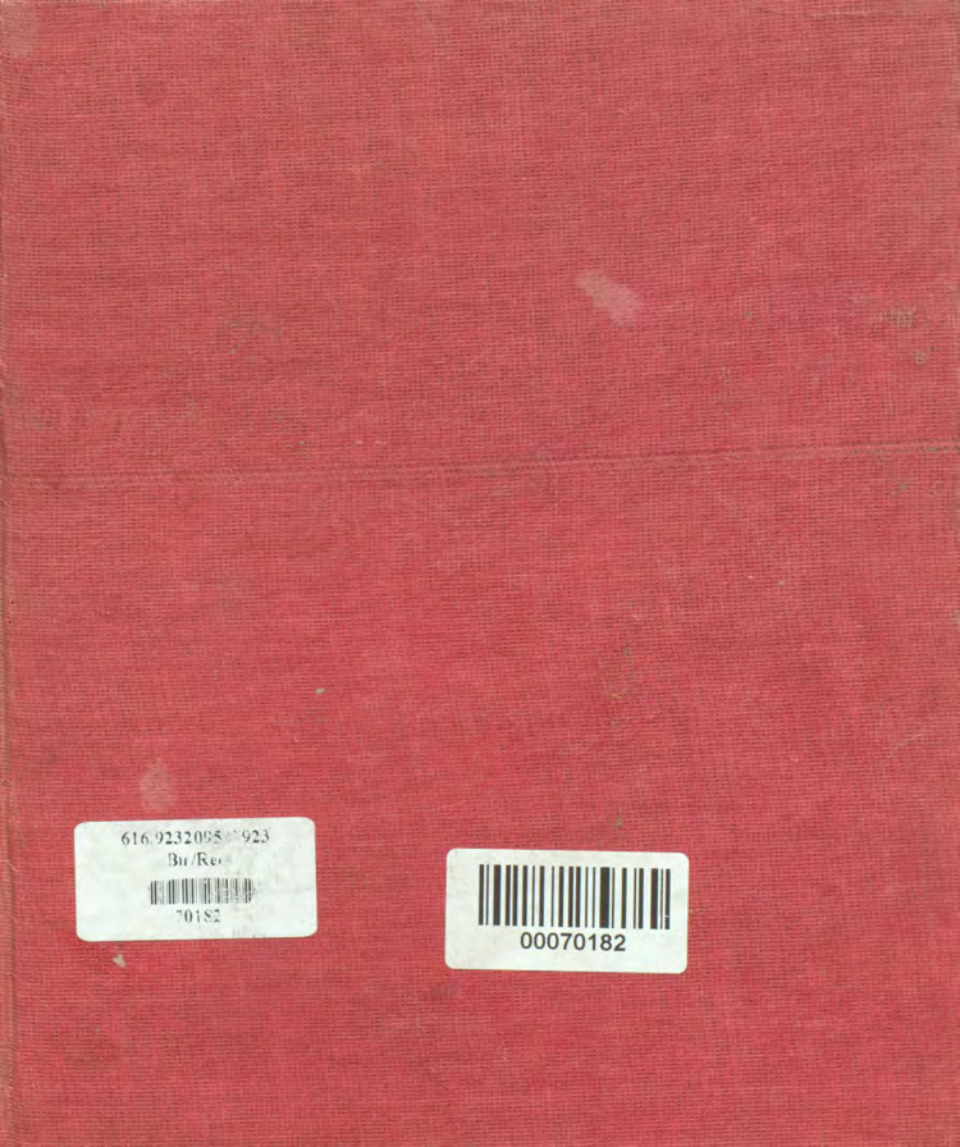
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THE RECENT EPIDEMICS OF PLAGUE IN BOMBAY.

By H. M. BIRDWOOD, C.S.I., LL.D., M.A.,

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[Paper read before the Geographical Society of Manchester, on Thursday, the 19th May, 1898.]

IT is to the courteous invitation with which I have been honoured by the Geographical Society of Manchester that I owe the opportunity which is afforded me this evening of addressing you on the subject of the recent visitation of plague in Bombay. My sense of the honour is the keener because the society has chosen as our Chairman my distinguished friend, Dr. Ward,—who is your friend also,—and it gives me the sincerest satisfaction, on returning to England after many years of absence, to be thus once more brought into association with him. With Dr. Ward as sponsor, I can with confidence appeal to you for indulgent treatment of all shortcomings in this paper.

At the outset, I would explain, as I explained lately when addressing the Society of Arts in London on the same subject, that there are various questions connected with plague epidemics which can be discussed with profit only by experts in science. I cannot pretend to be an expert at all. But there are many points of view from which the subject can be approached; and an account, though by a layman, of some of those features and incidents of the plague which became generally known in Bombay during the recent epidemics, of the conditions—whether climatic or local or personal—which seem to favour the growth of epidemics, of the measures adopted in Bombay for the repression of the plague, and of the further measures by which it is hoped to prevent outbreaks of plague hereafter, will not, I trust, be uninteresting. In the course of the narrative it will be necessary for me to refer to some technical details which could be better dealt with by a member of the medical profession. As to these I shall be guided mainly by the recorded opinions of experts.

Medical authorities are agreed as to the identity in character of the "bubonic fever" of Bombay with the disease historically known as the plague, and also as to the identity of the highly infectious pneumonic type of the disease, in which the characteristic enlargements of certain glands are not always seen, with the "Black Death" of the fourteenth century, which was, indeed, introduced into Europe from Asia, and not improbably

from an endemic centre of plague in India itself. It infected the whole continent of Europe and most of the outlying islands, and Greenland also; and destroyed, in Europe alone, about 25 millions of human beings,—that is, about one-fourth of the population,—and was succeeded at intervals by numerous epidemics of the same disease, which retreated slowly eastwards towards the close of the seventeenth century; lingering, however, in the south-east corner of Europe, till the present century. The last epidemic of plague in England was in 1665, the year of the Great Plague of London; but sporadic cases were registered in London in most of the following years till 1679. The last great outbreak in France was in 1720. It was believed till lately that, in Africa, the disease had never extended beyond the northern coast belt. Egypt has been the starting point of numerous epidemics which have overrun that tract since the sixth century, just as Turkey was the point of departure for every inroad after the plague area had become narrower in Europe. In Asia, epidemics were most frequent, up to the year 1844, in Syria and Asia Minor. Since 1850, they have occurred in Persia, Arabia and Mesopotamia. At one time, Persia was considered the eastern limit of the plague area in Asia, but this view is no longer possible, as we now have ample evidence of the occurrence of plague at Agra and many other places in India in the seventeenth century. At Bombay, it appeared at intervals from 1689 to 1702. In Central India, it was present from 1813 to 1821, and extended to Rajputana, the Runn of Kutch, certain towns in Guzerat, to Kathiawar and to Sind. In 1836, and again in 1837, it broke out at Pali, in Marwar, and spread to Jodhpore, Meywar and Ajmere. The virulent form of plague known in British Garhwal and Kumaon as *Gola*, or *Phatkya rog*, or *Mahamari*, has probably existed in the hill tracts of India and China from time immemorial. In 1846-47, it found its way to the sources of the Ramganga, and swept away nearly the whole population of a village at a height of 7,000ft. above the sea. It reappeared at intervals at different places in Kumaon and Garhwal till 1894. In 1853 it descended to the plains of the Moradabad district, where it remained during the following year. The plague committed frightful ravages in Yunnan from 1871 to 1873, and was still prevalent there in 1879. The southern slopes of the Himalayas and the mountain valleys of Yunnan are now regarded as endemic centres of plague.*

*As regards plague foci, Professor Koch records the following observations, in his recent report to the German Public Health Society, on the spread of the bubonic plague in India: "The historically known ways of the spread of the disease prove the existence of a series of geographically independent plague foci. The Mesopotamian one has been known since ancient times. A second focus from which the disease spreads both south-eastwards to China and southwards to India must be presumed to exist in Thibet, and a third at a point in the district of Assim, on the Arabian Coast. I have found a fourth in Kissiva, north of our African colonies. We owe it to the extremely laborious, but also brilliantly successful work of the Army Surgeon Zupitza

Medical authorities have also accepted as conclusive the investigations conducted by Dr. Kitasato and Professor Aoyama of Japan during the Hongkong epidemic of 1894; and Kitasato's "bacillus" is now universally recognised as the essential cause of the plague. The *Bacillus pestis* is classed in the vegetable kingdom under the *Bacteria*, which are among the simplest of living forms, and consist of a single cell, with a limiting membrane. They are found almost everywhere. Some of them are our best friends. Others are the causes of disease in the animal kingdom. The plague bacillus belongs to the group of parasites or disease-producing bacteria which find a home in the bodies of certain animals. It is a little less than $\frac{1}{25000}$ of an inch in breadth and $\frac{1}{10000}$ of an inch in length. Its size, however, is not constant. To adopt an illustration used by Dr. Woodhead, it would take about 500 millions of such organisms, laid side by side, to cover a postage stamp. Insignificant, however, as it seems, this minute organism has been so deadly an enemy of the human race that popular as well as scientific interest cannot fail to be aroused in regard to it in the course of any inquiry about the plague. There are questions regarding its manner of life — its individual life, whether on the ground, or in the air, or in the bodies of men—and its social life—in societies which cannot be numbered—questions also as to the conditions which favour its growth and the development of its poisonous power, and as to its methods of attack and the supposed susceptibility to attack of different races and communities, and as to the best means of repelling its attacks, many of which must remain unanswered for the present and until the bacillus and its habits can be studied, not merely when it is captive in the laboratory, but when it is a free agent also. But we can, at all events, note some of the ascertained facts.

Dr. Kitasato has found bacilli in the blood, the swollen glands, and other internal organs of plague patients. He describes them as rods, with rounded ends, which are readily stained by the ordinary aniline dyes, the poles being stained darker than the middle parts, and presenting a capsule, sometimes well marked. They show little movement. They can be cultivated on suitable media; and, when thus growing in a "colony," they can be seen with the naked eye. When grown in beef tea, they make the medium cloudy, and on potatoes they look whitish-grey. Their growth is strong in blood serum at the normal heat of the body. They require oxygen for their

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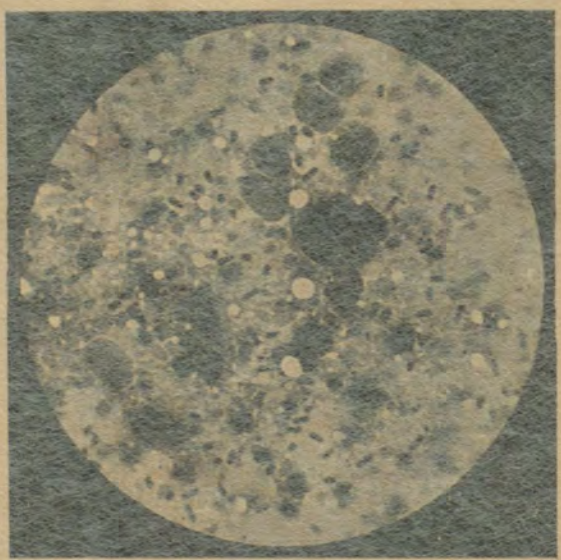
that we are now fully informed as to the epidemic there, which has been known for about eight years. There is not the slightest doubt that the disease of the negroes there is both bacteriologically and pathologically the genuine bubonic plague. The country of Kissiva, however, cannot be regarded as the real focus, which must be sought for near Lake Victoria. The cultivation of the banana probably contributes considerably to the spread of the plague bacillus, for the negroes there live exclusively on bananas, the broad leaves of which, a metre high, form such dense groves that neither a breath of air nor a ray of sunshine can penetrate, and they must be regarded as the real breeding places of the plague germ."

growth and multiply by fission—that is, by a lengthening of the cell and its transverse subdivision into two or more cells. Each divided portion is a new plant, which repeats in a few hours the process to which it owes its own existence. Reproduction thus proceeds in a rapid geometrical progression. No spores have as yet been found in plague bacilli.

The magic-lantern slide which will now be exhibited has been prepared from a photograph of bacilli appearing in a magnified section of an infected gland. The photograph is by Dr. Bitter, of Cairo, who was in Bombay during the epidemic of 1896-97.



From a Photo by] *[Dr. Bitter, Cairo.*

Bacilli in an Infected Gland (Magnified).

Dr. Kitasato and Dr. Yersin have found that cultures of bacilli are destroyed in a few hours by a temperature of 136° Fahr., and in a few minutes by a temperature of 212° Fahr. Sir William Robinson says that "its great enemy is the sun." According to Dr. James, it is easily killed by direct sunlight, by heating to a temperature of 140° Fahr., by antiseptics and by weak acids; but it can withstand simple drying for five or six days. "In suitable conditions," says Monsieur Haffkine, "the germs will multiply indefinitely. When the nutritious medium is exhausted, but the bacilli are protected from desiccation or invasion of other growth, they may remain alive for many months, possibly for years. In the ordinary con-

ditions, when exposed to the vicissitudes of the open air, bacilli of plague captured by the bacteriologist die out very rapidly, in about a week at the utmost. Plague epidemics, however, often last for years." He adds that "when the germ is got hold of" it almost dies if the bacteriologist only looks at it. And again: "The germs may rise, like any other dust, in the air, but under these conditions, when surrounded by air and light, they get weakened rapidly and die. In any case, it is so when the bacteriologist keeps them under watch." It is probable that the germ is most actively poisonous "immediately on leaving a diseased body or after an interval of a day or two." There may, however, be germs which require longer periods for acquiring full strength. "This is not known." At present it is supposed that the virulence of the microbe depends "on its previous passage through a susceptible animal or man." The probability of germs retaining their virulence for any length of time while in the air appears to Monsieur Haffkine to be remote. His opinion that the microbe, as scientifically studied in a test tube, "is somehow different from the complex phenomena which determine an epidemic" is, I believe, one that is shared by others who have lately been engaged in scientific research in Bombay.

Dr. Yersin once thought that he had traced plague bacilli in the soil, but he found afterwards that he had been mistaken. Bacilli have not, so far as I know, been found in the ground or in a free state in the air; but from observed facts connected with outbreaks of plague the inference is reasonable that the plague germs exist in the soil and in the air as well as in the bodies of human beings and of certain ground animals, notably rats and mice, in which they are parasitic; and competent authorities find no difficulty in holding that plague is due to the invasion of the body by these poisonous germs.

The plague is defined by Dr. J. F. Payne, the learned president of the Pathological Society of London, as a specific febrile disease, transmissible from the sick to healthy persons, and accompanied usually by buboes and sometimes by carbuncles. Dr. Arnott, in his recent address to the Medico-Chirurgical Society of Glasgow University, classifies plague cases, as observed in Bombay, under four heads: (1) mild cases with buboes; (2) severe cases with buboes; (3) pneumonic plague, with or without buboes; and (4) abdominal plague, resembling typhoid fever. "There are also mild cases—ambulant plague—which seldom come under treatment, but may spread the disease." According to Dr. Payne, the mild plague sometimes precedes and sometimes follows severe epidemics, as on several occasions in Mesopotamia, from 1873 to 1878, and in Astrakan in 1877. This form of the disease is, in Dr. Kitasato's opinion, dependent on the same bacillus as that which produces the severe form, "but in an attenuated or benign phase." In

this opinion Dr. Cantlie concurs. The symptoms of severe plague, as observed in Bombay, vary with the precise type assumed by the disease. According to Dr. Childe, in the form with buboes, the attack is sudden, being often accompanied by rigor at first. Then fever comes on, with bad headache, vomiting, and frequently delirium. The temperature rises to 104° Fahr., or more. The respirations are increased and the pulse is rapid. The face of the patient assumes an anxious expression, and he feels a pain in the groin and under one arm. Later on, a mass of painful glands is seen on the tender spot. Formerly no cases were diagnosed as plague unless there were external "buboes." Dr. Childe describes also the form without buboes, which resembles bronchitis or pneumonia, and is usually fatal within three or four days. The onset is sudden, with rigor, fever, headache, etc. Symptoms of bronchitis or pneumonia then appear, but the patient is much more ill and his fever is much higher than can be explained by the amount of lung disease present. The lymphatic glands are either normal or only slightly enlarged, and there is no pain. This form of the disease is the "pneumonic plague." Dr. Hojel has described some cases of the "abdominal type of plague," which, in their early stages, bear a very strong resemblance to enteric fever, the differential diagnosis being very difficult. Dr. Weir, the Executive Health Officer of the Bombay Municipality, notices the desire to wander, which is sometimes a "strange and pathetic" symptom of the disease. A patient, with a temperature of more than 100°, suddenly leaves his house, and if he has any money he drives to the railway station, with the intention of going to some place by rail, he cannot say why. Dr. Weir noticed this desire to wander in all classes, and it often precedes high fever and delirium. During the epidemics of plague in the Middle Ages, certain black patches on the skin, known in England as "tokens," were considered to be sure precursors of death, and gave rise to the name "Black Death." No such symptoms were, I believe, observed in Bombay, and their absence suggests to Dr. Arnott the probability that typhus and other diseases may have been mixed up with the plague in those epidemics. According to the observations of Dr. Leumann, local inoculation through abrasions, however minute, such as cuts and scratches of the skin, has been the most common method of invasion in plague cases, especially among the poorer classes, who go about, for the most part, bare-footed, and with their arms and legs insufficiently covered. The congestion and enlargement of the lymph glands nearest the point of inoculation indicates an attempt at local resistance. Where the organism attacked resists the micro-organism, the disease remains local, but where the power of resistance of the organism is lowered, or was, from the first, slight, "the bacilli become generalised throughout the body,

reaching the blood either by the lymph channels, or, in some cases, by direct extension into the veins in and around the glands, and producing true septicæmia. Such cases are almost always, if not invariably, fatal." In the pneumonic variety, described by Dr. Childe, the bacilli may be either breathed into the lungs, as in "primary plague pneumonia," or the plague may involve the lungs among other organs, during the course of the septicæmic form, thus producing "secondary plague pneumonia." And thirdly, as Dr. Leumann observes, invasion by absorption from the alimentary canal "is quite a likely mode of invasion, and should not be forgotten as a possible one." Dr. Herbert observes that, in the more fatal septicæmic type of plague, in which there are few or no obviously enlarged glands, the bacillus is found in large numbers in the blood; but in the ordinary bubonic type the blood is not the chief seat of the disease. The members of the Russian Plague Commission in Bombay, Professor Wysokowicz and Dr. Zabolotny, found that in bubonic cases the enlargement of the glands was mostly due to the presence of enormous numbers of bacteria. In primary pneumonic plague the sputum is full of bacilli. These facts show that the microbes multiply after they enter the body. Observation in the hill tracts of northern India favoured the conclusion that the period elapsing between the infection of the patient and the manifestation of plague symptoms is very short. Dr. Hutcheson says that the disease may prove fatal "within 24 to 48 hours after exposure to infection." The period of incubation was supposed at Hongkong to range from two and a half to six days, but in some cases to be as long as nine days. For the purposes of the plague regulations prescribed by the Venice Sanitary Convention of the 19th of March, 1897, the period of incubation is fixed at ten days.

The question of protection against invasion is necessarily of the greatest practical importance. Monsieur Haffkine's prophylactic treatment by inoculation with a fluid serum containing plague germs destroyed by heat and certain products resulting from the process of preparation has been much in favour. Many thousands of persons in Bombay and elsewhere have voluntarily undergone this treatment, and the immunity afforded has been remarkable. I will give one instance only out of many. At Damaun, in the Portuguese territory to the north of Bombay, there were 6,033 persons who were not inoculated, of whom 1,482, or 24·5 per cent, died of plague. Of 2,197 who were inoculated only 36, or 1·6 per cent, died. According to Dr. Herbert, the evidence that has been collected shows that the person inoculated is apparently rendered so resistant to the plague organism that when it is introduced into his system it will fail to multiply, or fail "to take." The time required for producing immunity is shorter than in any

known protective treatment against other diseases, being less than one day; whereas in anti-cholera inoculation it is four days, in vaccination against small-pox seven days, in inoculation against anthrax twelve days, and against rabies fifteen days.

As regards the medical treatment of plague cases, it is perhaps sufficient if I quote the opinion of so competent an authority as Dr. Arnott that no remedy has been discovered which can be relied on. Dr. Childe says that many methods have been tried in Bombay, "but none with certain success."

For the past three centuries the question whether the plague is contagious or not has formed the subject of controversy. Dr. August Hirsch, of Berlin, regards the discussion as closed. There may be a difference of opinion, he says, as to the ways and conditions of communication, but not as to the fact itself. During the Bombay epidemic of 1896-7, opinions were mainly divided on the question whether the plague is highly infectious or only slightly infectious. In the paper which I read before the Society of Arts in February last I adduced some evidence on both sides of this question, as furnished by recent experiences in Bombay and its neighbourhood. I will not go over the same ground now, but will content myself with stating the conclusions of Dr. Childe, who is able from his own observations to express the belief that both parties are right, according to the type of plague under consideration. "In many cases," he says, "the ordinary bubonic form of plague is not particularly infectious, and every one has seen that attendants in such cases, both in hospitals and private houses, do not readily take the disease"; nor, if care be used in the sick room, is the patient likely to convey the disease. With the pneumonic form of plague "the conditions are quite different, for here the patient is freely coughing up and scattering around him what is practically a virulent pure culture of the plague bacillus." This form is highly infectious. Many of these cases, moreover, were not at first recognised as plague at all, so that the usual disinfection was not carried out. Pneumonic cases have thus had a large share in spreading the disease. Dr. Childe thinks it probable that the "Black Death" was really a severe type of the plague pneumonia. According to the Chroniclers, both medical and non-medical, the spitting of blood was one of the commonest phenomena in the course of that disease. The bubonic and pneumonic forms of the disease were both recognised by the natives of Guzerat in 1820, and Dr. Hirsch has no doubt as to the identity of the fatal Pali plague of 1836 (of which, according to Forbes, expectoration of blood was a symptom) with the "Black Death" of the fourteenth century.

Dr. Henderson, of Karachi, thinks that in cases of importation of plague by infected persons the germ requires a period of "local incubation" before attaining its full virulence, and

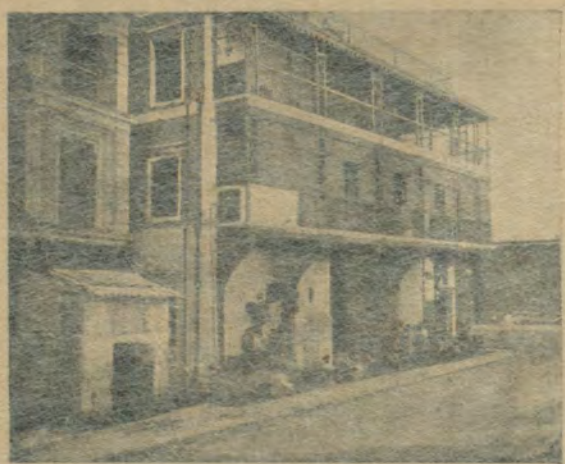
that the imported infection is not probably strong enough to infect men, but infects rats, and through them the people of the country. The period of local incubation he considers to be the time between the importation of a case and the infection of the rats. Human agency, according to this view, would be the means of importation and rats the disseminating agent. The Plague Commissioners, Drs. Reade and Lowson, also believe that rats convey the disease from place to place, and you may remember that it was lately reported that it was by this agency that the plague had been brought into Calcutta.*

Dr. Weir has pointed out, however, that the death of rats is not the first phenomenon. It is preceded by a migration of rats, urged possibly by the instinct of safety, and Mr. Logan, the late Collector of Thana, in his report on the measures taken in that district, has described the "Rat's Progress" from south to north, through successive quarters of the town of Bandora, and to villages beyond the limits of the town, which were not infected till the rats brought the plague. Mr. Snow, the Municipal Commissioner of Bombay, in his able report on the epidemic of 1896-7, observes that the presence of rats probably nullifies to an enormous extent the advantages to be derived from ordinary remedies, and points out that the plague in Bombay followed the migration of rats, the course of which was generally from east to west and then northwards, up the sides and centre of the island.

With reference to the question whether a microbe can exist in an infectious condition for any time outside the body of a patient, it appears that a German investigator, working in Japan, has found that it can remain alive in linen for more than a month. The two Goanese servants who were attacked with plague on arriving in London from Bombay, in 1896, were found to have unpacked and worn in London some clothing which they had brought with them. It is supposed that they were thus infected in London, as they were in good health throughout the voyage.

At one time it was believed that the plague was due to poisonous exhalations from corpses, but this theory, though it was supported by the French commissioners who studied the plague in Egypt in 1828, was shown by Dr. Hirsch, more than sixteen years ago, to be untenable. Nor is it possible to hold that the vegetable organism which is now known to be the exciting factor of the disease can be produced spontaneously; nor is it evolved by certain states of the atmosphere, or of the soil or of the animal in whose body it finds a home. Each plague germ has a parent, and if there is an outbreak of plague in any place, the plague germs must have been brought to that

place at some time or other before the outbreak. When the germs are brought to a crowded city in which the conditions favourable for their growth are present, they multiply rapidly by the simple process of fission which I have already described. But for the development of the disease the organism must be present. When certain conditions of climate are present also, the disease may become epidemic on almost any soil, in any latitude and at any elevation, if only the community attacked is predisposed by local or personal conditions to yield to its attacks. If the poison of plague is not present, then there can be no plague, even though all the conditions which ordinarily favour the growth of an epidemic, when once the poison has been introduced, be present and abound.



The House in the Mandvi District where the Plague was first discovered, in Bombay, in September, 1896.

It is not possible to trace the circumstances connected with the importation of plague which produced the first Bombay epidemic of 1896-97. It has been variously held that the bacillus was introduced with mouldy grain from Central India, or else by traders from Hongkong, or else by wandering mendicants from a plague centre in Northern India; but nothing is really known as to the time and manner of importation. All that is known is that cases of plague occurred in Bombay in February or March, 1896; that more cases occurred in May and June and July; that these cases were not recognised as plague at the time; that the disease was actually present and spreading in a densely-crowded community for several months before its real character was known or even suspected, and that it established itself unmistakeably as an epidemic from the beginning of

October, 1896. The difficulty of controlling it, in such circumstances, has been compared by Monsieur Haffkine to the difficulty felt in Australia in dealing with the pest of rabbits, and in France with the phylloxera, and in South Africa with the rinderpest. If the first pair of rabbits imported into Australia had been promptly destroyed, there would have been no pest of rabbits, and a similar remark applies to the phylloxera. But the plague bacillus, when once established, was very much harder to deal with, not only on account of its minuteness, but also on account of the rapidity with which it reproduces itself.

I will now compare some of the incidents of the first epidemic of 1896-97 with those of the second epidemic which has been recently raging in Bombay, in reference, more especially, to the conditions or factors which seem to exert an influence on the growth of epidemics of plague.

To explain the re-establishment of an epidemic during the recent cold season, it is not necessary to enquire as to the possible importation of fresh plague germs after the practical cessation of the first epidemic, at the close of April, 1897, for at no subsequent time has Bombay been entirely free from the plague.

I have prepared from the official records of plague cases and plague mortality for the twelve months from October, 1896, to September, 1897, the following statement, in a tabular form, showing the number of seizures and the number of deaths in each month, and the percentage of deaths to seizures in each month :—

Month.	No. of Seizures.	No. of Deaths.	Percentage of Deaths to Seizures.
October, 1896	389	276	70·96
November, „	333	268	80·48
December, „	1,655	1,160	70·09
January, 1897	2,374	1,825	76·87
February, „	3,173	3,072	96·81
March, „	2,495	2,257	90·46
April, „	1,418	1,267	89·35
May, „	448	327	72·99
June, „	182	98	53·84
July, „	62	44	70·96
August, „	124	70	56·45
September, „	221	168	76·01
Total for 12 months	12,874	10,832	84·13 Percentage for 12 months.

This statement shows that, in May, 1897, the number of cases officially registered was reduced to 448 and the number of deaths to 327, as against 1,418 cases and 1,267 deaths in April. In June, the corresponding figures were 182 and 98; and in July, 62 and 44. The minimum was then reached, for in August there were 124 cases and 70 deaths and in September 221 cases and 168 deaths. Now in October, 1897, though the number of deaths officially registered as due to plague was less than in October, 1896, yet the excess of the total mortality from all causes over the normal mortality was much higher; and as, for reasons which I will explain presently, this excess may be safely regarded as representing approximately the actual mortality from plague, it may be held that the plague had once more become epidemic in Bombay in October, 1897; though the commencement of the second epidemic is referred, in some of the returns from Bombay, to a later period. If the plague mortality be deduced in this way, the growth of the plague to the dimensions of an epidemic must be referred in both years to the beginning of the month of October. At this period, in each year, it was clear that cases of plague were no longer merely sporadic. In the four weeks ending on the 27th October, 1896, there were 784 deaths from plague. In the corresponding period of 1897 there were 1,264 deaths.

Though the plague was checked in July, 1897, and though its virulence, as shown by the proportion of deaths to seizures, had been greatly reduced even so early as in May, 1897, yet it was not completely stamped out; and so long as there were any sporadic cases at all, the danger remained; and the mortality in the second epidemic has been very heavy, notwithstanding the thoroughness of the sanitary measures adopted in 1896-97 and up to the present time. In the 30 weeks from the 2nd October, 1897, to the 29th April, 1898, the mortality from plague has amounted to 25,059 deaths. During the corresponding period in 1896-97 it amounted to 20,365. Experience shows that when, on the cessation of an epidemic, the plague lingers in a sporadic form in a crowded population, it may at any time re-appear as a malignant epidemic, if only the conditions favourable for its growth present themselves—and some of these conditions are beyond human control.

Thus, in London, during the period from 1543 to 1679, the presence of plague was recorded in 84 years, but only six of these were characterised by serious epidemics. (See Appendix No. 1.) Three at least of these six years were years of drought; and Mr. Baldwin Latham infers, from a careful examination of mortuary statistics, that when the plague is present, a hot and dry season favours the growth of an epidemic. He finds that the conditions, when measured by the dryness of the air, were identical in the London epidemics and in the Bombay epidemic of 1896-97.

The Hongkong epidemic of 1894 was preceded by an unusual drought which lasted for seven months. Sanitary operations were carried out with the utmost vigour in Hongkong, but the plague re-appeared early in 1896, on the close of a year in which the rainfall was one half of the average. It would seem that, unless the plague germ can be completely eradicated from any place in which it has established itself, there is always the risk of fresh outbreaks of the disease, even though there may be no fresh importation of the contagion. During the period to which I have referred, the plague mortality in London was, in many years, very low indeed. In the twelve years ending with 1624, it never rose to 40 deaths in any year; and in nine of these years it was below 20. In 1617 it fell to six. In 1624, there were 11 deaths, but in the following year the figure exceeded 44,000. So again, in the 15 years preceding 1665—the year of the Great Plague—the highest mortality in any year was only 36; and in the year immediately preceeding the Great Plague, only six. But this was enough to keep the germ alive and capable of fearful development, in a "hot and dry" autumn, such as that of 1665. Other favouring conditions may also have been present; but the recurrence of the plague in London in years of drought and the circumstances connected with the two outbreaks at Hongkong are significant.

Both as regards the distribution of rainfall and the mean annual temperature, the circumstances of the year 1896 were altogether exceptional in Bombay. The actual rainfall was above the average, but practically the monsoon rains were at an end about the middle of August. From the 19th August to the 29th September, the rainfall was less than 3½in., as against an average, for that period, of 13in. It was a famine year, but in two former famine years, 1876 and 1877, much more rain fell in the month of September than in 1896; and October, 1896, was dry and hot. The mean annual temperature of the year was 80·7° Fahr.—the highest temperature on record, except in one year, for 51 years. Such exceptional circumstances may have promoted the rapid development of plague when once the germ had entered the city, undetected, and multiplied for several months.

These abnormal conditions of rainfall and temperature did not repeat themselves in the monsoon and autumn of 1897; but nothing could prevent any ordinary cold season in Bombay from being a dry season, except the prolonged continuation into the cold weather of the south-west monsoon rains to an extent not yet recorded. Till about the middle of April, in every year, a north-east monsoon wind blows steadily throughout the cold weather. As it passes over wide tracts of parched-up land, it is a thoroughly dry wind before it reaches Bombay. If, therefore, there is any force at all in Mr. Baldwin Latham's theory,

the ordinary climatic conditions of a Bombay cold season must always be favourable to the growth of plague, if only the germs are present, whether they have been freshly imported from plague centres or other infected places, or survived in sporadic cases following a previous epidemic.

These climatic conditions are probably similar to those of a dry English autumn. It is shown by the burial returns kept under the orders of Thomas Cromwell, Lord Privy Seal, since the year 1538, and recently examined by Mr. Baldwin Latham, that the plague was always at its worst in the London epidemics in the late summer and autumn months. In 1592, the worst months were July, August, and the first half of September; in 1603, from the middle of July till early in November; in 1605-6, and in the following year, August, September, and October; in 1624-5, from early in June to the end of October; and in 1664-5, from early in July till near the end of November. (See Appendix No. 2.)

Plague seasons have also been noticed elsewhere, as in Syria and Aleppo, Smyrna, Trebizond, and Algiers. In Persia, the season varies in different parts of the country.

Statistics have been preserved of the plague mortality at Alexandria in each of the years from 1834 to 1843, and are noted in Dr. C. Creighton's excellent translation of Dr. August Hirsch's "Handbook." It was found that, in those years, the plague generally became epidemic between October and January and sometimes later. In most years there was a distinct increase of mortality in the month of February. In 1835, March was a month of exceptional mortality, there having been 4,459 deaths, against 951 in February and 2,016 in April. It was observed that the epidemic generally ceased, in each year, at Alexandria, on St. John's Day—the 24th June—and at Cairo, at the summer solstice, the 21st June.

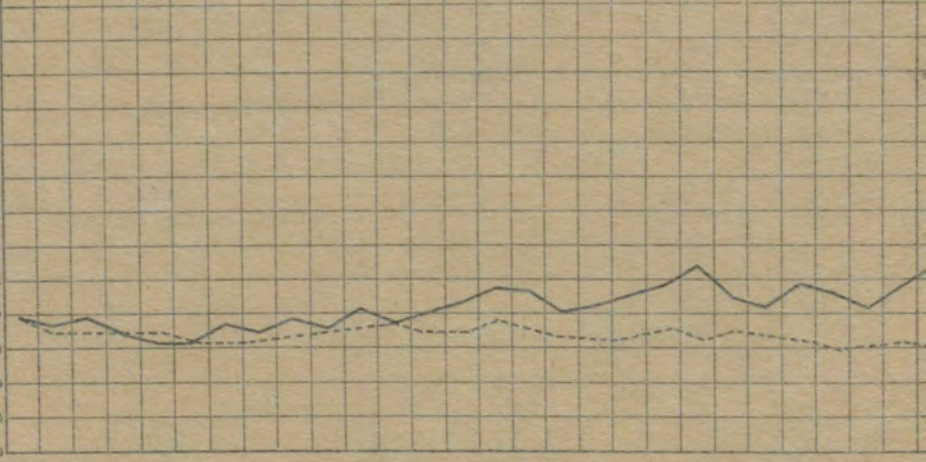
In northern countries, as observed by Dr. Payne, epidemics have generally started in the spring, been most active in August and September, and ceased in winter; but there have been exceptions to this rule. In Moscow, in 1770, and on the Volga, in 1878-79, the plague raged during severe winter weather. In the British districts of Garhwal and Kumaon, in Northern India, where the plague is endemic, or "at home," and in Arabia, no particular association with the seasons has been traced. In Irak, according to Dr. Payne, the plague dies out suddenly in the summer. When the temperature rises above 86° it begins to diminish, and it ceases abruptly at a temperature of 113°. In the Bombay cold season of 1896-97, the temperature ranged, during the months of January, February and March, when the mortality was highest, from 87·6°—the highest limit reached on the 8th January—to 60°, the lowest limit reached on the 26th January. It rarely

exceeded 85° during this period or fell below 65°. The mortality was very high when the temperature was lowest, and fell steadily as the temperature steadily rose from the 1st March to the end of April, as you will see duly recorded in the chart on the screen, which was prepared under the directions of General W. F. Gatacre, late President of the Plague Committee in Bombay. On the 27th April, 1897, the thermometer stood at 93°. In the week ending on that day, the daily mortality from plague was reduced to 10.

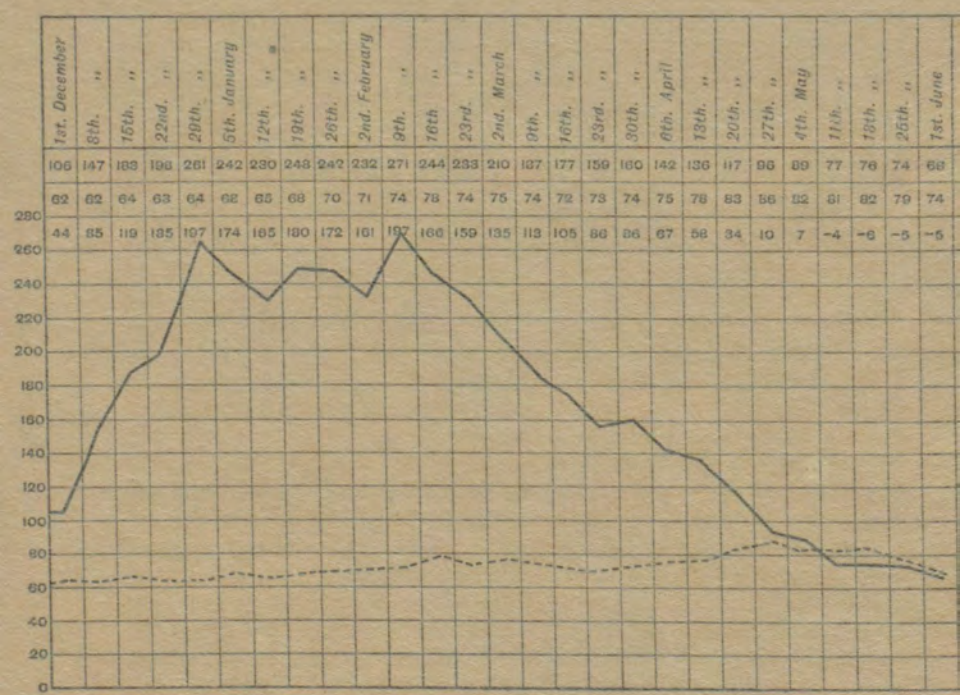
The mortality from plague during the second epidemic at Bombay, while exceeding the mortality of the first epidemic, has yet followed it in such a manner as to suggest the control of seasonal influences. Though the mortality during the present outbreak has been higher, it does not necessarily indicate a higher death-rate in proportion to the population than in 1896-97; for the exodus of inhabitants has not been so large as in that year. But whatever the death-rate may have been, at any time, in either epidemic, the plague has been at its worst in both years in the driest season of the year. Once more the plague has declined, as in 1897, when the season has changed and the dry, north-east monsoon has given place to the south-west monsoon wind, laden with all the vapour which it has absorbed in its passage over the Arabian Sea. This change generally begins about the middle of April, and is completed in the two months which precede the great annual downfall of monsoon rain in June.

It will be instructive to contrast the mortality for corresponding periods of the two epidemics. According to the official registers, the plague mortality for the 30 weeks ending on the 27th April, 1897, amounted to 10,227 deaths, and for the corresponding weeks of the second epidemic to 15,611. These periods respectively represent the duration of the two epidemics. If these periods be divided into successive groups or stages of four weeks each, it appears that, in the first epidemic, the plague, according to the official registers, was at its worst in the fifth and sixth stages, ending respectively on the 16th February and the 16th March, 1897. In the second epidemic it has also, according to the same registers, been at its worst during the corresponding stages, ending respectively on the 18th February and 18th March of the present year. The result is somewhat different according to the preferable method of computation, based on the total mortality from all causes, to which I have already referred. The official method of registration is admittedly defective. It is certain that at one time many deaths from plague of one type or another were not recorded as such. In all plague epidemics there are cases in which death occurs very rapidly, without some of the symptoms which are generally regarded as characteristic. Cases of the

A	19th. May	26th. "	2nd. June	9th. "	16th. "	23rd. "	30th. "	1st. July	14th. "	21st. "	28th. "	4th. August	11th. "	18th. "	25th. "	1st. September	8th. "	15th. "	22nd. "	29th. "	6th. October	13th. "	20th. "	27th. "	3rd. November	10th. "	17th. "
B	79	76	77	69	63	63	74	71	76	71	81	75	80	87	91	90	80	83	87	96	108	87	83	95	92	85	95
C	79	75	72	73	69	62	61	63	64	69	72	75	72	72	77	73	71	68	68	70	65	69	64	63	59	60	62
D	0	1	5	−4	−6	1	13	8	12	2	9	0	8	15	14	17	9	17	19	26	43	18	19	32	33	25	33



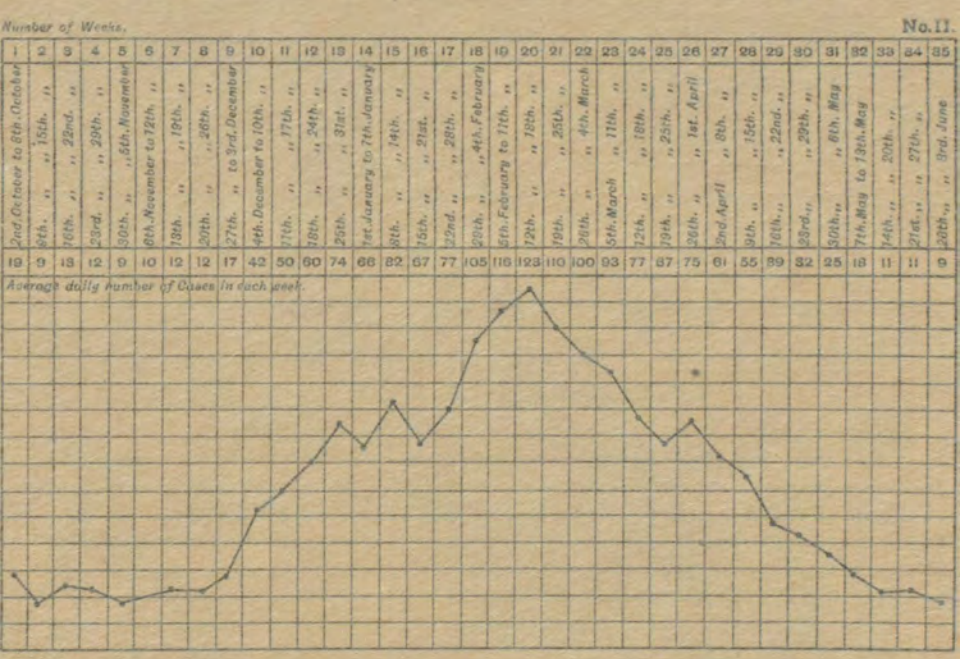
	1st. December	8th. "	15th. "	22nd. "	29th. "	5th. January	12th. "	19th. "	26th. "	2nd. February	9th. "	16th. "	23rd. "	2nd. March	9th. "	16th. "	23rd. "	30th. "	6th. April	13th. "	20th. "	27th. "	4th. May	11th. "	18th. "	25th. "	1st. June
	106	147	183	198	261	242	230	248	242	232	271	244	233	210	187	177	159	160	142	136	117	98	89	77	76	74	68
	62	62	64	63	64	62	65	68	70	71	74	78	74	75	74	72	73	74	75	78	83	56	52	61	82	79	74
	44	85	119	135	197	174	165	180	172	161	197	166	159	135	113	105	86	86	67	58	34	10	7	−4	−6	−5	−5



NOTE.—In this chart the figures in line B indicate the daily average mortality, from all causes, in each of the weeks indicated in the headings of columns (marked A)—that is, in each week from the week ending on the 19th May, 1896, to the week ending on the 1st June, 1897. The figures in line C indicate the daily average mortality, from all causes, in each of the corresponding weeks in the preceding five years; and the figures in line D represent the excess of the daily averages for 1896-97 over the normal daily averages, or a deficiency, as the case may be.

most fatal type were at first classed either as remittent fever or else as some disease of the respiratory system; and many plague cases were concealed by the friends and relations of patients. It was soon apparent that cases registered as plague fell far short of the excess of the total mortality from all causes over the normal mortality from all causes, and competent authorities came to the conclusion that the greater part, if not the whole, of this excess ought really to be treated as due to plague.

It was found that after making allowances for errors of registration due to faulty diagnosis and other causes, the plague mortality for the seven months from October, 1896, to April,


Number of Weeks.
No. II.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35
2nd October to 8th October
9th " " 15th " "
16th " " 22nd " "
23rd " " 29th " "
30th " " 5th November
6th November to 12th " "
13th " " 19th " "
20th " " 26th " "
27th " " to 3rd December
4th December to 10th " "
11th " " 17th " "
18th " " 24th " "
25th " " 31st " "
1st January to 7th January
8th " " 14th " "
15th " " 21st " "
22nd " " 28th " "
29th " " 4th February
5th February to 11th " "
12th " " 18th " "
19th " " 25th " "
26th " " 4th March
5th March " 11th " "
12th " " 18th " "
19th " " 25th " "
26th " " 1st April
2nd April " 8th " "
9th " " 15th " "
16th " " 22nd " "
23rd " " 29th " "
30th " " 6th May
7th May to 13th May
14th " " 20th " "
21st " " 27th " "
28th " " 3rd June
19 9 13 12 9 10 12 12 17 42 50 60 74 66 82 67 77 105 116 123 110 100 93 77 87 75 61 55 89 32 25 18 11 11 9
Average daily number of Cases in each week.

1897, was probably not much, if at all, below 20,000; whereas the official returns indicated a mortality, as I have just said, of a little more than 10,000 deaths.

Before going further I will invite your attention to the three charts which will now be thrown on the screen. In the first of these, the dark line shows the average daily mortality from all causes in Bombay in each week from the week ending on the 19th May, 1896, to the week ending on the 1st June, 1897, and the dotted line shows the average daily mortality for the corresponding weeks in the preceding five years. The spaces between these two lines for the seven months from October, 1896, to April, 1897, represent the excess of the actual mor-

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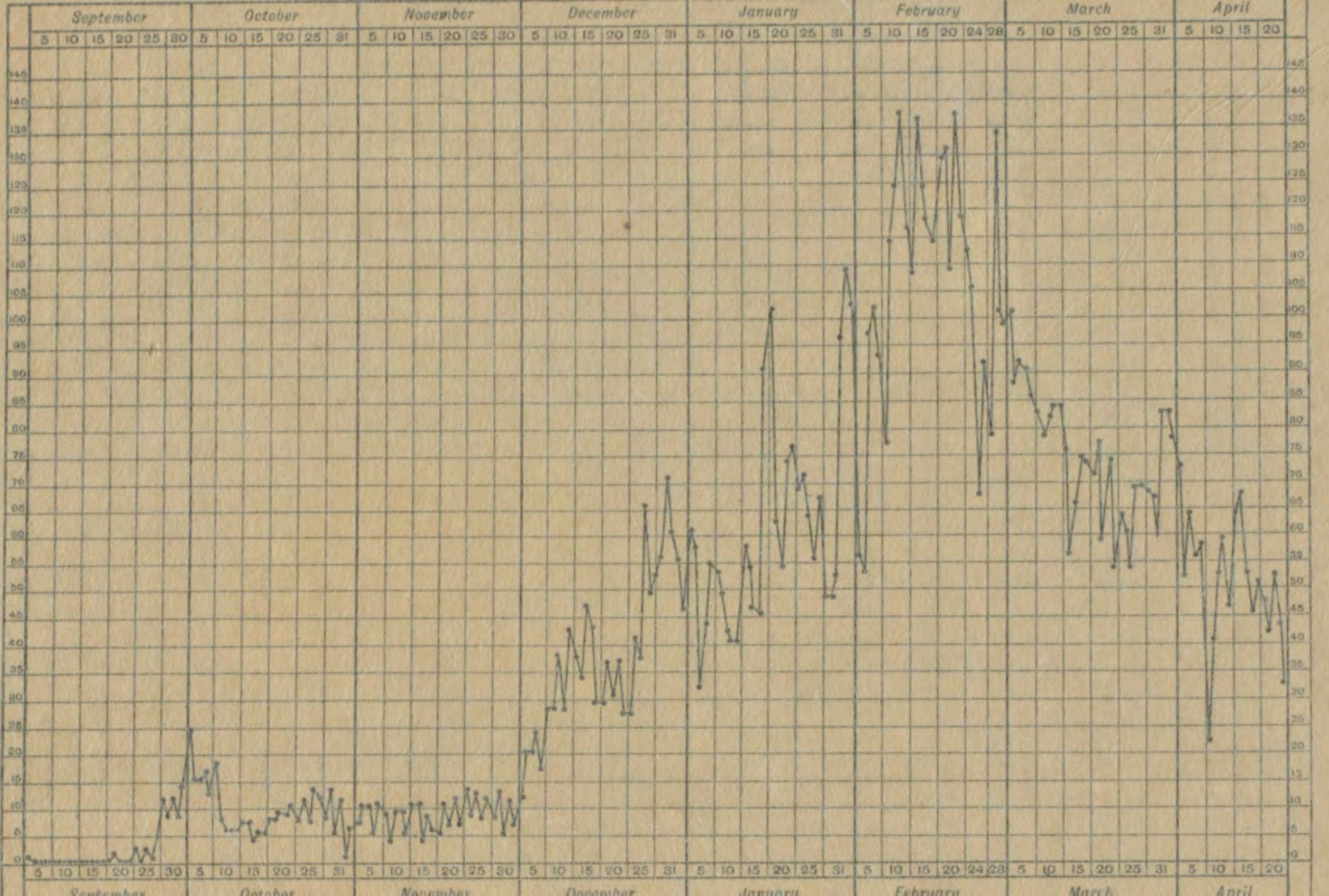
September
October
November
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5 10 15 20 25 30
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5 10 15 20 25 30
5 10 15 20 25 31
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5 10 15 20 24 28
5 10 15 20 25 31
5 10 15 20

tality over the normal mortality so long as the first epidemic lasted, or, in other words, they represent the average daily mortality due to plague in each week during that period. Figures indicating the average daily excess in each week are noted on the chart. The second chart shows the average daily number of plague cases—whether fatal or not—reported by the Municipal Health Department for each of the 35 weeks from the 2nd October, 1896, to the 3rd June, 1897. The third chart shows the course of plague mortality, as recorded by the Health Department, from the 1st September, 1896, to the 20th April, 1897.

The system of registration is, I believe, better now than it was a year ago. Still, it may be doubted whether it is even yet perfect, for the official returns are still much below the figures deduced from the total mortality tables, and there has been no other epidemic prevalent in Bombay to which the excess can be attributed. There seems to be no valid reason why the same method should not be adopted for computing deaths from plague during the second epidemic as was accepted as approximately correct in 1896-7. By this method we arrive at the following results for successive stages of four weeks each, in each epidemic, as now shown on the screen:—

Stages of 4 weeks each in the First and Second Epidemics.	Plague Mortality in each Stage.	
	First Epidemic.	Second Epidemic.
No. 1, ending on 27th Oct., 1896, and 29th Oct., 1897	784	1,264
„ 2, „ 24th Nov., 1896, and 26th Nov., 1897	945	1,113
„ 3, „ 22nd Dec., 1896, and 24th Dec., 1897	2,681	1,428
„ 4, „ 19th Jan., 1897, and 21st Jan., 1898	5,012	3,435
„ 5, „ 16th Feb., 1897, and 18th Feb., 1898	4,872	5,860
„ 6, „ 16th March, 1897, and 18th March, 1898 ...	3,584	6,520
„ 7, „ 13th April, 1897, and 15th April, 1898	2,079	4,400
„ 8 (2 weeks only) ending on 27th April, 1897, and 29th April, 1898	408	1,039
Total for 30 weeks (between the beginning of October and the end of April)	20,365	25,059

These figures show that, in the first epidemic, stages Nos. 4 and 5 were the worst, and in the second, stages Nos. 5 and 6.

The highest average of weekly mortality in any stage of the first epidemic was reached in stage No. 4, ending on the 19th January, 1897, when it amounted to 1,253 deaths, and the highest actual mortality in any week occurred in the first week

of that stage—when it reached 1,379—and again in the week ending on the 9th February, when it again reached the same figure. But the average weekly mortality in group No. 5, in which this latter week occurs, was 1,218. In the next two stages it fell rapidly, and in the last two weeks of the first epidemic the average weekly mortality was 204. In the second epidemic the mortality was higher in stages Nos. 1 and 2, and lower in the next two stages than in 1896-7, and higher again in stages Nos. 5, 6, and 7. Up to the end of stage No. 5 the week showing the maximum mortality was the third week of that group, that is, the week ending on the 11th February, 1898, when the mortality was 1,622. In 1897 the mortality declined steadily after the close of the corresponding week, but it has been otherwise in the present year. In the week ending on the 18th February the mortality amounted to 1,500. The figures for the next four weeks, ending on the 18th March last (which constitute group No. 6), were successively 1,541, 1,563, 1,587, and 1,829. This last week has been the worst of all. The mortality fell in the next week to 1,633, and in the three subsequent weeks, ending on the 15th April, it fell successively to 1,189, 879, and 699. Though the mortality in stage No. 7 has been higher in 1898 than in 1897, yet the epidemic has declined more rapidly during this stage than was the case a year ago. The average weekly mortality in the two weeks ending on the 29th April, 1898, was 519. The practical cessation of the second epidemic may now be regarded as established, for in the week ending on the 6th inst. the mortality fell to 229, and in the following week, ending on Friday last, it was reduced to 105. The statistics clearly point to climatic influence as a controlling factor in the development and decline of both epidemics.

If, notwithstanding the cessation of the plague in an epidemic form in the present month of May, as in May, 1897, it is not completely stamped out in the next few months, but should linger on in sporadic cases, as in the period from May to September, 1897, then there will be ground for fearing that, when the climatic conditions again become favourable in October next, Bombay will not escape a third pestilence; for we cannot fight against such conditions. We try to produce beneficial changes of climate in certain areas by extending the growth of forests, but no such methods seem to be open to us in the narrow and crowded area of the town and island of Bombay.

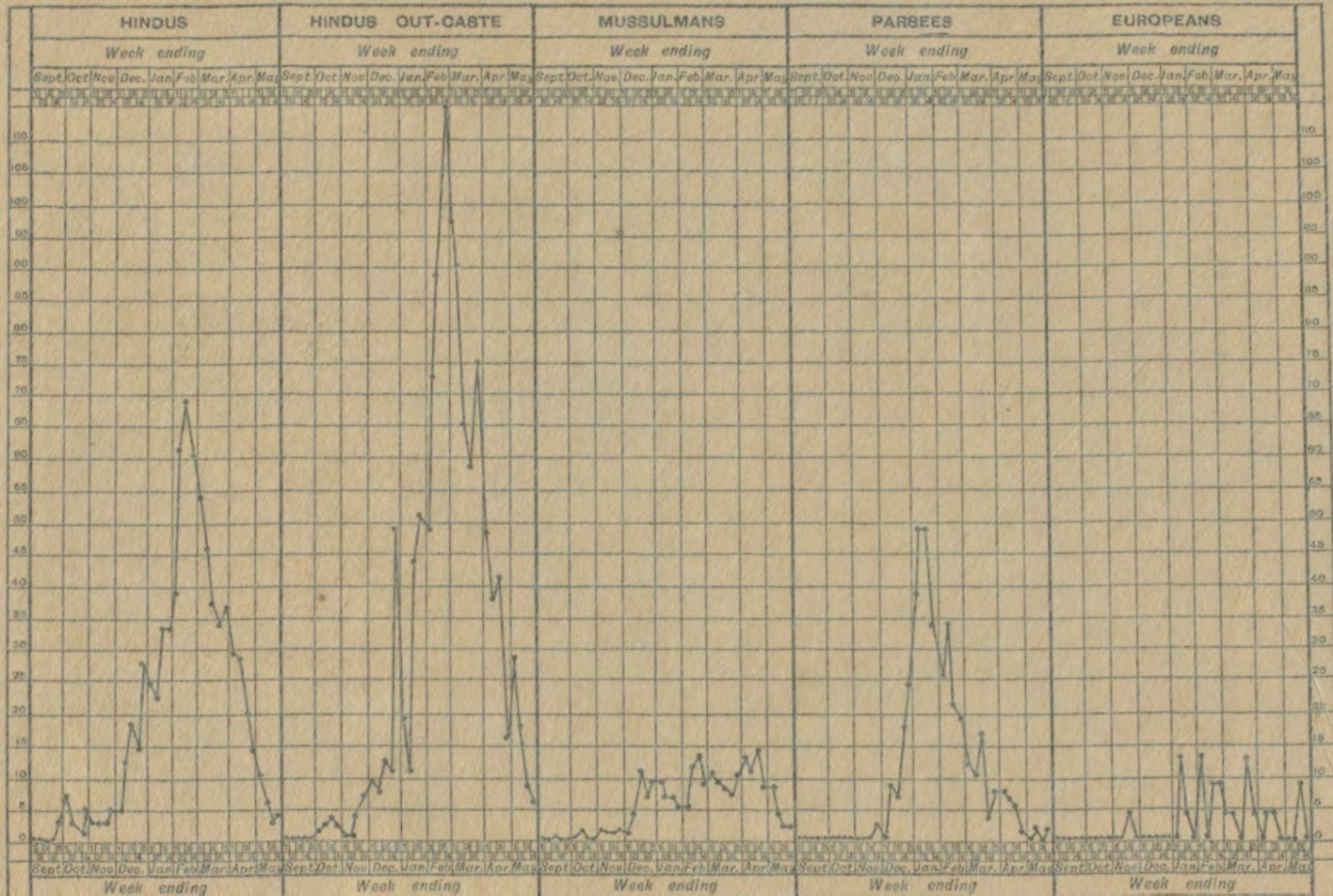
If climatic influence were the only factor to be dealt with, we might indeed despair. But there are other conditions which can be controlled. There can be no question, for instance, that when the health of a crowded population is lowered by insanitary surroundings, the people become liable

to attack. It is as true now as it was in the Great Plague of London that the poor, the weak, and the sickly suffer most. Even so long ago as in 1362 it was noticed of the plague of that year by a contemporary writer, Symon de Covino, as narrated in Mr. Wright's introduction to "Piers Ploughman," that "he who was ill nourished with unsubstantial food fell before the slightest breath of the destroyer. To the poor death was welcome, for life is to them more cruel than death. But death respected princes, nobles, knights, judges, gentlemen. Of these few die, because their life is one of enjoyment." Dr. Hirsch thinks it probable that the "social element" gives the key to such differences as have been noted in several epidemics of plague in respect of the susceptibility of various races. The comparative immunity enjoyed by certain communities in Bombay, and especially by Europeans and Mohammedans, and to a less degree by Parsis, as traced in the chart which will now be shown on the screen, may perhaps be thus accounted for.

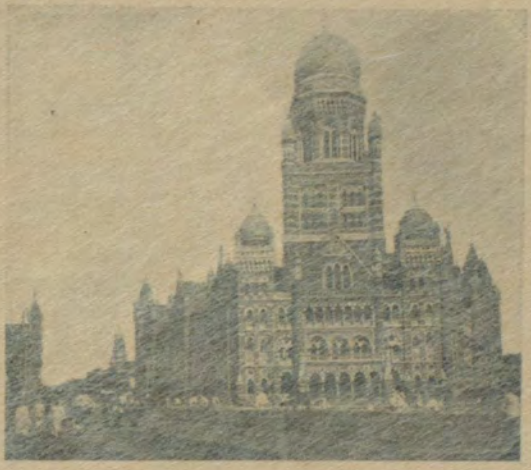
Europeans enjoyed comparative immunity also at Hongkong in 1894, but not to the same extent in 1896. Again, in Egypt, the plague was not so fatal to Europeans as to Arabs, Nubians, Berbers and Negroes.

It has been pointed out by Dr. Hirsch that accumulations of filth in streets and houses, the defective disposal of refuse of all kinds, the over-crowding and insufficient ventilation of dwellings, the "frightful misery" resulting from the disregard of considerations of rational hgyiene "in all that relates to dwellings, clothing and the like," have always fostered the epidemic prevalence of plague. "The classes most exposed to such injurious influences have suffered from plague most severely." In Bombay, some of these conditions have been present; and it is to the necessity for their abatement that attention has been constantly directed since the outbreak of the epidemic of 1896-97. Splendid work has been done both by the Executive officers of the Municipality and by General Gatacre and the Plague Committee in cleansing and disinfecting streets and crowded houses and drains, in removing obstructions to the entrance of light and air into infected buildings, in providing accommodation elsewhere, in hospitals or temporary huts, for the occupants of such buildings, and in destroying domestic refuse and articles likely to be infected.

Special importance was attached, from the first, to the disinfection of infected houses, which were treated practically as if on fire, and were flushed from flushing-pumps and fire-engines with water charged with disinfectants, chiefly cresol or phenyle preparation and permanganate of potash. Sulphur was burnt inside houses, particular parts of which were also lime-washed. Besides lime-washing affected houses the municipal officers undertook the work of lime-washing throughout


HINDUS
HINDUS OUT-CASTE
MUSSULMANS
PARSEES
EUROPEANS
Week ending
Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May.

the city on a very large scale, in advance of the disease. Whenever infected houses had been thoroughly cleansed and vacated for a short time, fresh cases of plague rarely occurred in them.



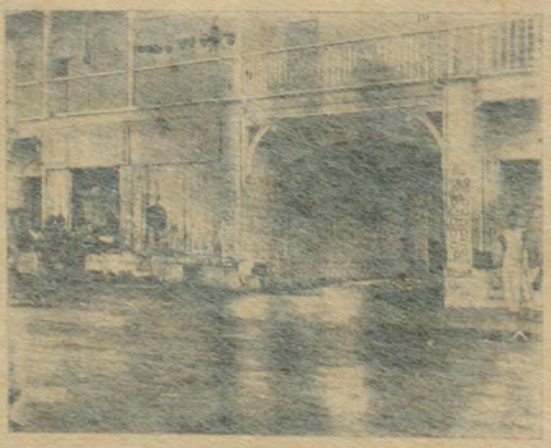
The Municipal Hall, Bombay, and Offices of the Municipal Commissioner, Executive Health Officer and other Officers of the Municipality.

Disinfection of Houses by Flushing.

There were some lamentable exceptions, however, to this rule, and among the photographic slides which I will presently show you, I have one of a house in which no less than 53 deaths

occurred. A house to house visitation by medical officers was instituted during the prevalence of the first epidemic. Street watering was suspended, and the water supply stopped or

Disinfection of Houses by Lime-washing.



From a Photo by] [*Professor Muller.*

A House in De Lisle Road in which 53 Deaths from Plague occurred—the largest number registered in any house. The circles on the wall indicate the deaths due to Plague.

reduced wherever it produced excessive dampness of the soil. Poor patients were treated medically, and unclaimed dead bodies cremated, at the public expense. Infected shops and ware-

houses were closed, and buildings unfit for human habitation were condemned. As observed by the Municipal Commissioner, Mr. Snow, in the report from which I have already quoted, "every kind of measure known to science was tried in Bombay at one time or another; and, as further experience was gained, the measures were modified from time to time." It was noticed by the leading scientists who visited Bombay that "never in the course of history had a rising epidemic of plague in a vast city been kept within such moderate bounds."

Early in January, 1897, the Government of India deputed Dr. Cleghorn, the Director General of the Indian Medical Department, to study the position of affairs in Bombay, and to settle a plan of action in the event of the spread of the plague to other places. Acting on the view that the incidence of plague was

A House condemned as Unfit for Human Habitation and thereafter Closed.

greatly due to local conditions, he recommended the removal from infected houses of all their inmates, the healthy as well as the sick, in order that the Health Department might the more effectually carry on the work of cleansing and disinfection. The adoption of Dr. Cleghorn's proposals in their entirety was found to be impracticable, but the Bombay Government distinctly recognised the evacuation of infected houses and the segregation of the healthy as desirable measures, which should be carried out to the utmost limit consistent with the avoidance of a general panic; and on the 23rd February the Government of India was informed that, on the occurrence of the plague, and even before its outbreak, gangs of labourers had been employed in taking off the roofs of houses, hundreds of which had in

consequence been vacated, and that huts had been erected for the inmates. The general object in view had thus been studiously prosecuted. In the course of the correspondence on this subject, the Government of India expressed its appreciation of the liberal measures sanctioned by the municipality and of the energy displayed by the Municipal Commissioner, the Health Officer, the Executive Engineer of the Municipality (Mr. C. James), and their subordinates.

The necessity for special hospital accommodation for plague patients and for increasing the number of such hospitals, so as to bring medical relief as near as possible to the dwellings of patients, and to provide for the treatment of patients of particular castes and communities in their own hospitals, became apparent at an early stage of the first epidemic. Such plague

From a Photo by] *[Professor Müller.*

Removal of a Family from a Plague-infected House to a Segregation Camp.

cases as could be segregated were at first sent to the Municipal Hospital in Arthur Road, which was opened for the treatment of infectious diseases before there was any indication of the plague. Up to October, 1896, the only other hospital where plague cases could be received was St. George's Hospital, which was available only for Europeans. In October, two private hospitals were opened by the Hindu community for Hindu patients, but were closed on account of the high mortality in them and the alarm caused by the establishment of hospitals in crowded localities. In December, hospitals were opened for Parsis and Jains and for the workpeople on the Port Trust Estate; and, in January, for Hindus and servants of Europeans. Much good work was done in this latter hospital, under the supervision of Professor Oswald Müller, of the Elphinstone

College, and Dr. Barker, at a critical time when alarm was spreading. The attention and kindness shown to patients went far to arrest the flight of household servants, which had already begun. The old historic Government House at Parel was placed by Lord Sandhurst at the disposal of the Health Department in February, and was afterwards maintained in complete working order by General Gatacre's Committee. It had surely never been put to a nobler use. A jail hospital in Parel Road, a second municipal hospital in Grant Road, and fourteen private hospitals were established in March. In the course of this month, the sanitary administration of Bombay was entrusted by the Government to General Gatacre's committee, which carried on with energy the work which had been thus begun. In April and May, seventeen more hospitals were opened, most of which were private hospitals. Before the middle of May, 1897, there were 41 plague hospitals in working order throughout the city, of which 31 were opened after the appointment of the committee. Of these 41 hospitals, 27 were private institutions for the use of members of particular castes, communities, or sects, and were under the supervision of medical officers working under the Plague Committee. All castes, creeds and races joined in the movement, and great credit is due to the munificent founders of these private hospitals, and to the medical men who most cordially came to the assistance of the committee in working them.

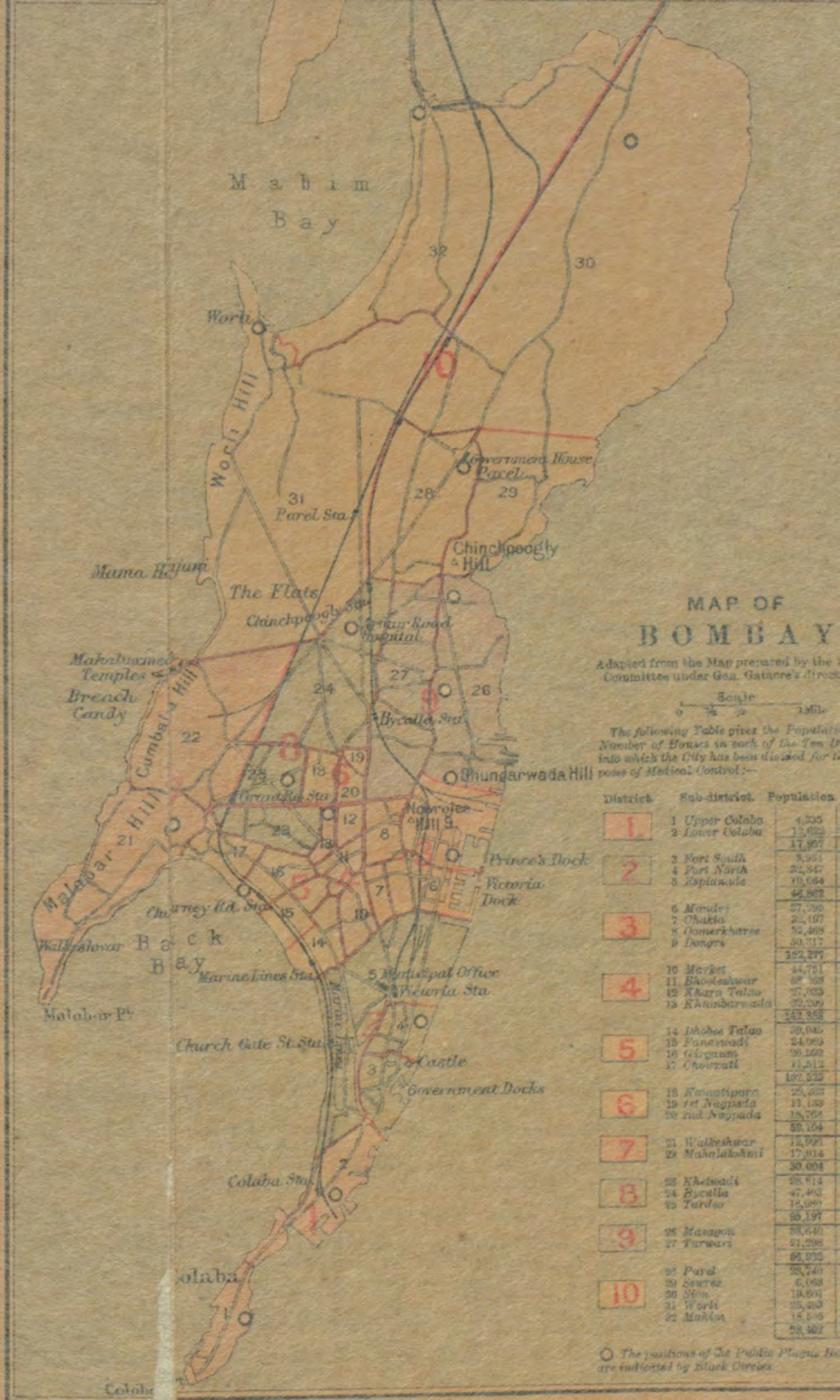
It was not, however, altogether a simple matter to secure these results. There can be no doubt that at an early stage of the epidemic the poorer classes had lost all confidence in the medical treatment of plague cases; and it is estimated that only a small percentage of persons attacked by the plague were seen or treated by medical men. Many infected persons were not brought to the hospitals till they were in a dying state; and when death, hastened possibly by the fatigues of a long journey, was seen in such cases to follow speedily on admission to hospitals, the wildest rumours regarding the alleged ill-treatment of patients by medical officers were spread abroad and believed. Many thousands of those who fled from Bombay were impelled by fear of the hospitals as much as by fear of the plague itself. But flight from unknown evils was not the only expression of popular ignorance, fear and distrust. On the 29th October, 1896, an attack was made by a gang of about 1,000 Hindu mill-hands on the Arthur Road Hospital, which it became necessary thereafter to protect by a police guard; and even before that date the members of the sanitary staff of scavengers were "seeking every excuse to leave the city," and were only kept in hand "by the ceaseless exertions of the Police Commissioner, Mr. Vincent, with his detective staff, the Health Officer (Dr. Weir) and his capable assistant, Mr. Leask."

There can be no doubt also that the people dreaded the separation of the members of families from each other which strict segregation of the sick involved. A Mussulman hospital near the Victoria Gardens was closed for this reason and a new one opened by General Gatacre in the quarter where the patients lived, so that their friends might be near. And indeed, when hospitals became numerous, the relaxation of the strict rule of segregation by the admission of friends tended greatly to allay popular suspicion. Even so early as in January, 1897, Dr. Cleghorn saw indications of a change in popular feeling, and noted that the people were beginning to recognise the advantages of sanitation.

From a Photo by] [*Professor Muller.*

A Family struck by Plague while in flight from Bombay. The father is concealed under the basket. The mother tries to hide an enlarged gland on her neck by holding her child close to it. The child also shows symptoms of Plague. They were all taken by Professor Müller to a Hospital, for treatment.

In consequence of the spread of the plague beyond Bombay, it became an Imperial necessity for the Government, early in March, 1897, to take the control of plague operations absolutely in its own hands, in order that individual efforts, whether of municipalities, local boards, or local officers, might be systematic and co-operative throughout the Presidency, and the methods employed consistent, complete, and, if possible, successful, before the commencement of the monsoon rains in June. It was this important consideration which led to the appointment of the Committee of which General Gatacre was the chairman, and Mr. Snow, Dr. Dimmock and Mr. James were members. The Committee was appointed to carry out measures of suppression and prevention in Bombay itself under


Mahim Bay
Worli
Worli Hill
Governor's House Parel
Parel Sta.
Chinchpoogly Hill
Mama Hajun
The Flats
Chinchpoogly Sta.
Grant Road Hospital
Mahalaxmee Temples
Breach Candy
Cumballa Hill
Bycalla Sta.
Chaupatty Sta.
Chaupatty
Chowpatty Sta.
Malabar Hill
Nowroje Hill S.
Prince's Dock
Victoria Dock
Back Bay
Walkeshwar
Marine Lines Sta.
Municipal Office
Victoria Sta.
Malabar Pt.
Church Gate St. Sta.
Castle
Government Docks
Colaba Sta.
Colaba
Colaba Pt.
MAP OF
BOMBAY
Adapted from the Map prepared by the
Committee under Gen. Gaitere's direct
Scale
The following Table gives the Populati
Number of Houses in each of the Ten D
into which the City has been divided for t
poses of Medical Control:—
District
Sub-district.
Population.
1 Upper Colaba 4,335
2 Lower Colaba 12,622
17,957
2 Fort South 9,951
4 Fort North 32,847
5 Esplanade 10,164
52,962
6 Mandvi 57,750
7 Chakla 35,197
8 Umerkhadee 52,488
9 Dongri 30,717
182,272
10 Market 14,751
11 Bhendibazar 6[illegible]
12 Khara Talao 37,029
13 Khambarwada 12,509
143,868
14 Dhobee Talao 30,040
15 Pydhonie 24,069
16 Girgaum 30,360
17 Chowpatti 11,812
107,330
18 Kumbharwada 25,633
19 1st Nagpada 11,139
20 2nd Nagpada 13,332
50,104
21 Walkeshwar 12,921
22 Mahalakshmi 17,014
30,008
23 Khetwadi 28,814
24 Bycalla 47,403
25 Tardeo 19,980
96,197
26 Mazagon 38,640
27 Parsi 21,296
59,936
28 Parel 28,240
29 Sewree 6,068
30 Sion 19,901
31 Worli 25,403
32 Mahim 15,846
95,462
The positions of 1st Plague Ho
are indicated by Black Circles

the immediate orders of the Government and was invested with the requisite legal powers, and, under the authority of the Epidemic Diseases Act, provision was made for the payment of all expenses from the Municipal Fund. The three principal objects to which the attention of the committee was directed were, (1) an organisation for the discovery of all plague cases, (2) the treatment of all cases in hospital, and (3) the gradual segregation, as far as possible, of persons who were probably infected by living in the same room with plague patients, or by attending on them; and Lord Sandhurst explained to the Chairman of the Committee the importance, in giving effect to these measures, of ensuring respect for the privacy of women and for religious usages, of opening the hospitals, as far as possible, to the friends of patients, for whom accommodation was to be provided near the hospitals, in order that they might see for themselves that the patients were well cared for, and of preventing distrust by persuasion and firmness.

Advantage was also to be taken of the assistance of native gentlemen, many of whom had already offered their services. In the spirit of these considerate instructions, and with tact and resourcefulness which never failed, General Gatacre, in association with his Committee, conducted the requisite plague operations as long as the first epidemic lasted. The city was divided into ten districts, and medical officers were placed in charge of them, with control over the inspectors and staff which had been organised and trained by the Health Department, and of sub-divisional medical officers recruited from the local practitioners and medical students.

I am indebted to General Gatacre for the map of Bombay, now on the screen. It shows the several districts into which the city has been divided and the positions of the principal hospitals. The number of houses in each district and other particulars are also noted on it.

In connection with this branch of the subject it will, I think, interest you to learn that soldiers, both British and Indian, eagerly responded to General Gatacre's call for volunteers; officers and men alike having sent in their names *en masse*. In all 557 men, of whom twenty were British soldiers, were employed on plague duty, under seven British officers, eleven Native officers, and twenty-five non-commissioned officers, British and Native. They lived in special segregation camps, and were taught nursing and the duties incidental to the search of houses for plague cases. The hospital at Government House, Parel, was worked by military labour and was used as the training school. Services of great value were rendered by this military contingent at a time when it was "almost impossible to procure servants of any description in plague hospitals." The troops were also employed in small detachments of three or four men

in house-to-house visitation with the Justices of the Peace and plague officers, and in disinfecting work. It is gratifying to note the extreme cordiality that sprang up between the soldiers and the civil population. "Every kindness, consideration, and civility were shown," says General Gatacre, "to the people by the men. This was thoroughly appreciated, and the result was the entire absence of complaint." The presence of troops with search parties prevented any opposition to sanitary measures which the ignorant or the turbulent classes might have been disposed to offer, while the presence of resident justices gave assurance to the people that their religion was not in danger.

It became a necessary part of the Plague Committee's duty to secure a competent staff of nurses for the plague hospitals.

A Plague Party, consisting of Medical Officers, Officers of the Health and Police Departments, Justices of the Peace, Soldiers, and Members of the Lime-washing and Ambulance Staff, starting for Plague Duty, early in the morning.

Before the arrival of nurses from England and elsewhere, timely assistance, the value of which it is impossible to over-estimate, was given, first of all, to the municipal authorities, and afterwards to General Gatacre's Committee, by the All Saints' Sisters at Magazon and the Daughters of the Cross at Bandora, and, later on, by Sisters from the Clare Road Convent and ladies connected with the Church Missionary Society, and also, I believe, by several Hindu and Parsi ladies. General Gatacre's full and comprehensive Report contains some pathetic stories, illustrating the gratitude of plague-stricken patients for the kindness and care shown them by these brave women, whose self-denying services will long be remembered in Bombay.

The skilled attention bestowed on plague cases by the sisters and, after they were relieved of their duties, by the efficient staff of nurses sent from England, or engaged locally, was of signal assistance to the Plague Committee and the large staff of civil, military and medical officers associated with them in their efforts to overcome the popular dread of hospitals and opposition to sanitary measures generally; and, long before the cessation of the first epidemic, these officers were welcomed by the people in their visits to infected houses and hospitals.

I have dwelt at some length on the measures taken both by the Executive officers of the Municipality and General Gatacre's Committee during the first epidemic of plague in Bombay, as I was in Bombay during most of the time that it lasted.

Arrival at a Plague Hospital of a Plague Patient discovered by a Search Party.

I cannot speak from personal knowledge of more recent operations, but I believe that, as a rule, they have been on the same lines as were followed in 1896-97, though as to some matters relating to the evacuation and disinfection of houses modifications have been found to be necessary. But, however that may be, it is certainly open to us to believe that the measures which have been adopted for the suppression of the plague in Bombay have not been without effect, even though the plague has not yet entirely passed away, and that the mortality would have been much higher in both epidemics if such vigorous efforts had not been put forward. The highest estimate of plague mortality during the epidemtc of 1896-97 did not exceed 2½ per cent of the normal population of 820,000, which, however,

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was greatly reduced for several months by a large exodus of the people. At one time Bombay was supposed to have been emptied of about one half of its inhabitants. But there were many immigrants also, and no accurate estimate of the actual population at any particular time seems possible. In the second epidemic, the plague mortality has slightly exceeded 3 per cent of the population. In most of the plagues of which we have any record, the mortality was much higher. In the second of the three great pestilences which devastated England in the 14th century,—when, however, no accurate registers were kept,—one half of the population is said to have been swept away. In the Great Plague of London 68,596 persons died, or nearly 14 per cent of the population. In the plague at Moscow, in 1570, the number of deaths was reported to have been 200,000. At Naples, 300,000 persons died in five months, in 1656; in Prussia and Lithuania, 283,000 persons died, in 1704; in Stockholm, 40,000, in 1710; in Marseilles, from 40,000 to 60,000, in 1720. Such contrasts with the mortality in Bombay may well be set to the credit of the vigorous sanitary measures adopted there; and a similar remark applies with even more force to the efforts of the authorities in Hongkong, where the number of deaths from plague amounted, in 1894, to 2,550, or only one per cent in a population of 255,000.

Still the measures adopted from time to time in Bombay have so far been palliative only. The ravages of the plague had been mitigated, but the disease was not stamped out entirely when it first ceased to be epidemic, and it is possible that the continuance of the plague, during the monsoon of 1897, though in sporadic cases only, may have been due to insanitary conditions which can and, therefore, ought to be removed.

The late Municipal Commissioner of Bombay, Mr. Acworth, considers that Bombay is not a "grossly insanitary town" (see the Society of Arts' Journal for the 25th February, 1898). If it be "judged by any standard hitherto attainable in the East," it is a "very sanitary" town, "the best . . . in India;" but there is "an enormous deal still to be effected," and its recent history has disclosed certain sources of danger which can no longer be ignored. Next to the evils produced by the density of the population and the overcrowding of "chawls" or tenements, the present Municipal Commissioner places those due to the water-logging of the city, which can be attributed (1) to the inadequacy of the means provided for the escape to the sea of all storm-water falling on the higher levels of the island, and (2) to the introduction of 30 millions of gallons of fresh water daily into Bombay from the artificial lakes at Vehar, Tulsi and Tansa, without any sufficient means for carrying it off. The level of the sub-soil water has thus been steadily raised. After the heavy rain at the beginning of the monsoon of 1896, five

millions of gallons of water were daily left in the soil, that being the excess of the amount of water coming into the city over the amount of sewage going out,—a balance indicating, as Dr. Weir observes, "a great danger at all times." Now, though epidemics of plague may be favoured by dryness of the air, though they have occurred in Kurdistan on dry limestone rocks at high elevations, and in Arabia on a lofty plateau, while swampy plains below have been exempt, yet elsewhere they have occurred in marshy places, as on the banks of the Euphrates; and in Bombay the municipal authorities were distinctly of opinion that dampness of houses, and even of streets, "had a malevolent influence on the propagation of the disease." The late Principal Medical Officer in the Bombay District, Dr. Hughes, was of opinion that the excess of sub-soil water favoured the growth of plague in those low-lying districts of Bombay where it first appeared; and so long ago as in 1890, Mr. Baldwin Latham drew attention to the alarming increase of certain respiratory diseases (not including phthisis), due apparently to the process, carried on for many years, of filling up the low-lying area to the north of the more populous parts of Bombay, known as "the Flats," over which the storm-water, falling on the inner slopes of the six trap hills which flank the island on its eastern and western shores, used formerly to find its way to the sea. In his report on the sanitation of Bombay, Mr. Baldwin Latham observes that underground water obeys exactly the same law as water flowing on the surface of land, and that the filling up of the flats with refuse, without providing for their proper drainage, has necessarily raised the level of the subsoil water as well as the level of the floods over the island, and that, as the process was carried on, deaths from the diseases referred to increased from 1,974 in 1880 to 4,132 in 1888. I have no figures for later years, but it is clear that, until effective means are devised and carried into effect, for lowering the level of the sub-soil water and otherwise improving the drainage system, the public health will be constantly menaced. The dampness of the soil may not have been proved to favour the growth of the bacillus, which, as I have said, has not yet been found in a free state in the soil; but defective drainage lowers the general state of health and so predisposes people to disease. The accumulation of an ever-increasing mass of town sweepings and other refuse on such a site as the Flats is also in itself a continuing source of danger.

Such, then, are some of the "local conditions" which it is incumbent on the responsible authorities to deal with. Nor can these matters be held to be of local concern only, and as possessing only a distant interest for us in England. Happily, the two or three cases of plague which appeared in London in 1896 were promptly discovered, and the disease did not spread. But how would it be if the plague crept in unperceived, in the

guise of pneumonia or typhoid—that is, in those very types in which it was not, for some time (indeed, until February, 1897), recognised as plague in Bombay—and obtained a footing in some of the crowded slums of our great seaport towns, in a hot and dry season, such as some of those seasons which favoured former epidemics of plague in this country? Even Sir Richard Thorne, speaking with full knowledge of the progress of sanitary science and practical sanitation in England, after explaining (at the meeting of the Society of Arts at which the subject of the plague in Bombay was discussed) that the removal of insanitary conditions was the basis of all English sanitary administration and the warrant for our abolition of quarantine, expressed the fear that the people of England might be "too credulous," if they "believed that we had removed the conditions which enabled those foreign infections to grow if they were imported."

Dr. W. J. Simpson (at the same meeting) seemed to go further. He has hitherto regarded the plague in Western India as "an expanding epidemic," favoured, indeed, by local conditions, "but acting independently of these." He bases this opinion on a study of historical facts connected with the gradual recession of plague from west to east, until it reached its home in China, and, after a period of rest, its gradual recrudescence in China and its advance westwards once more. If this theory is sound,—and Dr. Simpson speaks with authority,—if Bombay is but a halting place on the westward march, if it is the possible base for a fresh advance, by land or sea, then the methods adopted for the eradication of plague at a centre of diffusion of such magnitude, with so many lines of communication with other possible centres of diffusion, must be of the gravest concern to the whole civilised world.

The Bombay Government has given legislative effect, not a day too soon, to its proposals for the sanitary renovation of Bombay, which were explained by Lord Sandhurst at a meeting of the Legislative Council held on the 14th February last; and it is satisfactory to note that these proposals have been received both by the official and the non-official members of the Council and by the public with cordial approbation of the general policy of the Government. The leading exponents of public opinion describe it as a courageous and far-seeing measure, conceived with seriousness of purpose and with a genuine desire to promote the permanent interests of the city. Its general scope and objects are described by Lord Sandhurst, in his speech moving the first reading of the Bill, which has since been passed by the Council and awaits the assent of the Governor General. After referring to the difficulty of dealing effectively and promptly with the crowded areas on which buildings were erected long ago, in disregard of all sanitary principles, for the

accommodation, in some cases, of hundreds of lodgers, he said that it was to meet this difficulty that the Bill was framed. It was proposed to build "chawls" on proper principles, to house those who would be dishoused. In preparing a bold and comprehensive scheme for this purpose, the Government has considered the Report of the Bombay Extension Committee, appointed by Lord Reay in 1887, of which Sir Frank Forbes Adam was the chairman, the English Housing of the Working Classes Act of 1890 and the provisions of the Bombay Port Trust Act of 1890. It is proposed to constitute a special body, similar to the Port Trust, to carry out the requisite improvements; and in this body the most important interests of the city will be represented. As the welfare of Bombay is a matter of general concern to the people of all parts of India of which it is the trading centre, the general taxpayer will be called on to meet his share of the cost of the great enterprise. With the sanction of the Secretary of State and the Government of India, this contribution will take the form of a transfer to the new Trust, on favourable terms, of public lands valued at 57 lakhs of rupees and reclamation rights valued at 29 lakhs. As it is mainly with the sanitary aspects of this measure that I am concerned, I will not describe in detail the constitution of the proposed Board of Trustees, its methods of procedure, the machinery at its disposal, its relations to other local bodies, or its financial arrangements, and certain other questions. It will be sufficient to note that the powers of the Board will be determined by the nature of its work. "It will keep before it two main objects—the improvement of the existing city and its expansion in the future." "We propose," says Lord Sandhurst, "to empower the Board, in the case of specially unhealthy areas, to prepare comprehensive schemes of sanitary improvement, including the making of new and the alteration of old streets, the acquisition of frontages, the filling in of low-lying lands, the acquisition of houses condemned under Section 178 of the Municipal Act as unfit for human habitation, the construction of dwellings for the poorer classes, and the formation of open spaces. In other cases, when all that is required is better ventilation or better communications, the Board will have power to make new streets. In all cases where the operations of the Board displace any considerable part of the population, it will have power to provide elsewhere for the housing of the people so displaced. To provide for the future expansion of the city, the Board will have power to open up building lands by laying out new roads. It will also have power to reclaim any part of the foreshore vested in it." And again, he says: "We propose to endow the Trust with large powers and resources, but I do not disguise from myself that, here in Bombay, the field is very wide and the task a very great one.

The whole duty of the Board is the improvement of the city—nothing less—and it will not have done its task until every unhealthy area has been thoroughly dealt with and its defects remedied—until the city is traversed from end to end by wide roads in the direction of the sea breeze, to secure perfect ventilation, until the chawls for the poor have been provided on a scale and under regulations which will prevent over-crowding, and until ample provision has been made to meet requirements for the expansion of the city."

Lord Sandhurst took the opportunity to refute certain criticisms which condemned the policy of the Government as having been pursued with the aim and intention of belittling the Corporation, crippling its powers and reducing it in the estimation of the public. He entirely disclaims any such intention, and gives the assurance that the Government "will look forward, with a sanguine hope, for the co-operation of the Municipal Corporation with the new Trust," particularly in preventing the overcrowding of chawls under their Health Department, in the same way as the new Trust will look after overcrowding in the chawls for which they are to be responsible. He goes on to say: "It is not to be imagined that large sums of money are to be immediately sunk in palatial buildings. The main object of this Bill is not to beautify your city, but to do away with the insanitary areas and the unhealthy localities, and also to see that the areas over which the Trust hold their sway do not become the prey of the jerry builder. Hand in hand with the removal of these noisome quarters, in which so much sickness must prevail, will go the beautifying of your city. I claim for our Bill that it is a great expedient to deal with a very great and overwhelming calamity, and also to point out that, when the calamity shall have passed away, the expedient will continue on its beneficent course."

On the subject of the re-housing of the poor, Lord Sandhurst's speech contains the following memorable passage: "The re-housing of the poorer classes is one of the most important and attractive provisions of the Bill. I do not wish to refer too often to my visit to the slums, . . . but when I visited those slums, they reminded me most graphically of the stories that one used to read a few years ago regarding the dens and cellars in London where the poorest classes of the great metropolis herded together, where those who had to live by the sweat of their brow had to drag out a miserable existence. We do hope that, by these particular provisions of the Bill, we shall conduce to a higher state of civilisation and of greater vigour on the part of these people who contribute so much to the material wealth of this city. These people deserve our sympathy and assistance. We desire to place them in better houses, so that not only will the sun be let into their houses but into their hearts,

and into their very existence, and thus terminate the sad state of things amongst them, which at present cannot but be one of unhappiness, combined with toil. . . . The times are troublous in Bombay, and the cloud hangs yet heavily over the whole of us in whatever position we may find ourselves placed. But I do believe that a brighter future must be at hand, and that the most efficacious way of bringing it about,—the most expeditious, safest and surest way of bringing it about,—is on the lines which I have endeavoured imperfectly to explain."

These generous words, prompted by sympathy with a suffering population and by a true apprehension also of our duty in the face of dangers, capable, if not restrained, of indefinite and infinite expansion, will find an echo in the hearts of all who have been watching with anxiety the recent progress of events in Bombay. If the efforts there made could be supplemented by a comprehensive measure, such perhaps as it might be possible for the India Office to initiate, in concert with the Foreign Office, for the suppression of the plague in recognised centres of pestilence on the southern slopes of the Himalayas and in the mountain valleys of Yunnan, and possibly elsewhere in the Far East and in nearer Asia, then it might be possible also for us to hope that the present generation may yet witness the extinction of the most deadly disease which has afflicted the human race for the past two thousand years.*

APPENDIX No. 1.

Notes of the occurrence of Plague in London and some other places in England since the year 1543, and Returns of plague mortality in London, collected by Mr. Baldwin Latham, M.I.C.E., from various sources, and mainly from the Annual Records of Weddings, Christenings, and Burials, kept in pursuance of orders passed by Thomas Cromwell, Lord Privy Seal, in September, 1538.

1543 Plague in London. Lanquette's Chronicle.
1548 Pestilence in London. Stow's Annals.
1551 Sweating sickness in London. Lanquette's Chronicle and Fabian's Chronicle.
1552 Plague prevalent. History of the Weather.
1558 Plague in King's Lynn. Richards' King's Lynn.

* When I read this paper at Manchester, in May last, I had not seen the observations communicated by Professor Koch to the German Public Health Society, to which I have referred in an earlier note. The existence of a plague focus in Tropical Africa must now be held to be established. From that centre "the plague found its way some years ago to Tripoli." Professor Koch expresses the hope, however, that "it will not be able to resist the advance of general civilization, and that it will prove possible to expel it even from the last foci of the quite uncivilized parts of Central Asia and Africa, whither it has crept."

1562 Plague caused 20,136 deaths. Bills of Mortality, London. Brought by soldiers from the Continent. History of the Weather.

1562-3 City and Suburbs of London: Burials 23,630—Plague burials 20,136. Maitland's London, page 736.

1563 23,000 persons died in London of plague between 6th April and last day of November. Lanquette's Chronicle.

1564 Plague not fully ceased in London. Stow's Annals.

1569 Plague in London. Stow's Annals.

1574 Plague in the City. Maitland's London.

1575 Plague in King's Lynn. Mackerell's King's Lynn.

1581-2 Between 28th Dec., 1581, and 27th Dec., 1582, died of plague in London 6,930. Maitland's London.

1587 Plague raged in King's Lynn. Richards' King's Lynn. Burials in Leeds tripled by the plague. Annals of Yorkshire. Plague rife;—said to be due to famine. History of the Weather.

1588 Plague raged in King's Lynn. Richards' King's Lynn.

1589 Plague in Newcastle-on-Tyne. Newcastle Record.

Excessive drought.

1592 Plague in London. From March to December, 25,886 persons died, of whom 11,503 died of plague. Graunt.

1593 Plague in London. 17,844 died, of whom 10,662 died of plague, and the christenings were 4,021.

Wet year.

1594 No record for London. Very healthy at Croydon, also in County parish. (Referred to by Graunt.)

1595 No record for London. Great dearth in England. No records for London until 1603.

1603 Burials, London and Liberties, 42,042. Plague burials, 36,269.

1604 Burials, London, 5,219; Plague burials, 896. Plague raged in many country places.

1605	Burials, London,	6,391	Plague,	444
1606	„	7,920	„	2,124
1607	„	8,022	„	2,352
1608	„	9,020	„	2,262
1609	„	11,785	„	4,240
1610	„	9,087	„	1,803
1611	„	7,343	„	627
1612	„	7,842	„	64
1613	„	7,519	„	16
1614	„	7,389	„	22
1615	„	7,887	„	37
1616	„	8,072	„	9
1617	„	8,286	„	6
1618	„	9,614	„	18
1619	„	8,008	„	9

Tempests, Oct., Nov., and Dec. Drought.

	1620	Burials, London,	9,712	Plague, 21
	1621	„	8,123	„ 11
	1622	„	8,959	„ 16
	1623	„	11,112	„ 17
	1624	„	12,210	„ 11
	1625	„ [walls,	54,265	„ 35,417
	„	Burials within	14,340	„ 9,197
	1626	Burials, London,	7,535	„ 134
	1627	„	7,715	„ 4
	1628	„	7,743	„ 3
	1629	„	8,814	„ Nil
	1630	„	10,554	„ 1,317
	1631	„	8,358	„ 274
	1632	„	9,439	„ 8
	1633	„	8,428	„ Nil
	1634	„	10,865	„ 1
	1635	„	10,865	„ Nil
Great drought.	1636	„	23,359	„ 10,400
Summer hot and droughty.	1637	„	11,763	„ 3,082
	1638	„	13,624	„ 263
	1639	„	9,862	„ 314
	1640	„	12,771	„ 1,450
	1641	„	18,291	„ 3,067
	1642	„	12,167	„ 1,824
	1643	„	13,202	„ 996
	1644	„	10,933	„ 1,492
	1645	„	11,479	„ 1,871
	1646	„	13,532	„ 2,436
	1647	„	14,059	„ 3,597
	1648	„	9,996	„ 611
Commonwealth commenced.	1649	„	10,532	„ 67
	1650	„	8,581	„ 15
	1651	„	10,773	„ 23
	1652	„	12,539	„ 16
	1653	„	9,083	„ 6
	1654	„	13,126	„ 16
	1655	„	11,409	„ 9
	1656	„	13,752	„ 6
	1657	„	12,434	„ 4
	1658	„	14,993	„ 14
	1659	„	14,756	„ 36
Charles II.	1660	„	15,118	„ 14
	1661	„	19,771	„ 20
	1662	„	16,554	„ 12
	1663	„	15,356	„ 9
	1664	„	18,297	„ 6
Hot and dry.	1665	„	97,306	„ 68,596
	1666	„	12,738	„ 1,998
	1667	„	15,842	„ 35
	1668	„	17,278	„ 14
	1669	„	19,432	„ 3

1670	Burials, London,	20,198	Plague,	Nil
1671	„	15,729	„	5
1672	„	18,230	„	5
1673	„	17,504	„	5
1674	„	21,201	„	3
1675	„	17,244	„	1
1676	„	18,732	„	2
1677	„	19,067	„	2
1678	„	20,678	„	5
1679	„	21,730	„	2
1680	„	21,053	„	Nil

There are no further records of plague.

The plague ceased in England, but in the year 1720 there was a great outbreak of the plague at Marseilles, which lasted from May to December.

John Graunt. p. 33, 25th Jan., 1662. "Within this age, four times, great mortality, that is to say, the years 1592 and 1593, 1603, 1625, and 1636."

Page 60. Graunt. 1st Edition. Population of London estimated at 384,000. He calculated eight persons to a family.

Page 40. Appendix. Graunt. 6th Edition. Population in 1661, 403,000 in whole parishes within Bills of Mortality.

Dr. Farr, Vital Statistics, p. 131. In 1625, estimated death rate at 31 per cent; in 1665 at 43 per cent; in 1593 at 24 per cent.

Reflections on Weekly Bills of Mortality, published 1665, p. 37. "We reckon 47,520 families to be in and about London, allowing 54 families in each hundred yards, whereof there are 880 within and without the walls, and 494,000 people."

Sir Wm. Petty, F.R.S., pp. 64 and 67. In 1682, about 670,000 souls in London. 669,930 is the number of people now in London.

Dr. Farr. Vital Statistics, p. 131. The population of the City in 1631 was 130,178. This would probably be in the City only, and not the population within the Bills of Mortality.

The area and population within the Bills of Mortality of London have increased from time to time by the addition of parishes to the area.

Maitland's London, Vol. II., pp. 741-742. Gives a list of 3,038 burials which in the year 1729 were not taken into account in the Bills of Mortality of London.

742. The population of the City in 1631 was 130,268. This was within the wards and return made to the Lord Mayor.

Buried in 97 parishes	2,459	within the walls.
„ „ 16 parishes	3,697	
„ „ out parishes	2,132	
	8,288	

In 1631, Christened 8,524
„ Died of plague 274

APPENDIX No. 2.

Returns of the Weekly Mortality from all causes and the Weekly Plague Mortality during some of the London Epidemics, collected by Mr. Baldwin Latham, M.I.C.E., from the Yearly Bills of Mortality.*

A.

COLLECTION OF THE YEARLY BILLS OF MORTALITY FOR LONDON AND THE LIBERTIES THEREOF, 1592.

1592.	Burials.	Plague Burials.	1592.	Burials.	Plague Burials.
March 17.....	230	3	Aug. 11.....	1550	797
„ 23.....	251	31	„ 18.....	1532	651
„ 31.....	219	29	„ 25.....	1508	449
April 7.....	307	27	Sept. 1.....	1490	507
„ 14.....	203	33	„ 8.....	1210	563
„ 21.....	290	37	„ 15.....	621	455
„ 28.....	310	41	„ 22.....	629	349
May 5.....	250	29	„ 29.....	450	330
„ 12.....	339	38	Oct. 6.....	408	327
„ 19.....	300	42	„ 13.....	422	323
„ 26.....	450	58	„ 20.....	330	308
June 2.....	410	62	„ 27.....	320	302
„ 9.....	441	81	Nov. 3.....	310	301
„ 16.....	399	99	„ 10.....	309	209
„ 23.....	401	108	„ 17.....	301	107
„ 30.....	850	118	„ 24.....	321	93
July 7.....	1440	927	Dec. 1.....	349	94
„ 14.....	1510	893	„ 8.....	331	86
„ 21.....	1491	258	„ 15.....	329	71
„ 28.....	1507	852	„ 22.....	386	39
Aug. 4.....	1503	983			

Burials, March to December 25,886
Plague Burials, March to December ... 11,503

* With reference to these returns, Mr. Baldwin Latham writes:—"Since I sent you these records, I have found a detail record for the years 1568-64, which shows exactly the same incidence with regard to the plague outbreak in this Country as the other returns do."

B.

COLLECTION OF THE YEARLY BILLS OF MORTALITY FOR LONDON ONLY, 1603.

1603.	Burials.	Plague Burials.	1603.	Burials.	Plague Burials.
March 17.....	108	3	Aug. 11.....	1655	1372
„ 24.....	60	2	„ 18.....	2486	2199
„ 31.....	78	6	„ 25.....	2343	2091
April 7.....	66	4	Sept. 1.....	2798	2495
„ 14.....	79	4	„ 8.....	2583	2283
„ 21.....	98	8	„ 15.....	2676	2411
„ 28.....	109	10	„ 22.....	2080	1851
May 5.....	90	11	„ 29.....	1666	1478
„ 12.....	112	18	Oct. 6.....	1525	1367
„ 19.....	122	22	„ 13.....	1109	962
„ 26.....	122	32	„ 20.....	647	546
June 2.....	114	30	„ 27.....	536	432
„ 9.....	131	43	Nov. 3.....	609	491
„ 16.....	144	39	„ 10.....	473	355
„ 23.....	182	72	„ 17.....	384	251
„ 30.....	267	158	„ 24.....	198	105
July 7.....	445	263	Dec. 1.....	223	102
„ 14.....	612	424	„ 8.....	163	52
„ 21.....	867	646	„ 15.....	200	96
„ 28.....	1312	1025	„ 22.....	168	74
Aug. 4.....	1700	1439			

Burials, March to December 37,294
Plague Burials, March to December ... 30,561

C.

Collection of the Yearly Bills of Mortality for London, 1605-6.

1605-6.	Burials.	Plague Burials.	1605-6.	Burials.	Plague Burials.
Dec. 26.....	116	5	July 3.....	110	25
Jan. 2.....	151	6	„ 10.....	134	33
„ 9.....	138	4	„ 17.....	146	50
„ 16.....	138	3	„ 24.....	140	46
„ 23.....	121	6	„ 31.....	178	66
„ 30.....	101	3	Aug. 7.....	181	67
Feb. 6.....	105	5	„ 14.....	197	75
„ 13.....	118	7	„ 21.....	189	85
„ 20.....	109	12	„ 28.....	207	85
„ 27.....	117	9	Sept. 4.....	241	116
March 6.....	98	7	„ 11.....	216	105
„ 13.....	137	9	„ 18.....	214	92
„ 20.....	133	14	„ 25.....	204	87
„ 27.....	123	17	Oct. 2.....	256	141
April 3.....	114	13	„ 9.....	218	106
„ 10.....	145	27	„ 16.....	227	117
„ 17.....	129	12	„ 23.....	224	109
„ 24.....	110	11	„ 30.....	226	101
May 1.....	136	17	Nov. 6.....	183	68
„ 8.....	103	13	„ 13.....	162	41
„ 15.....	94	13	„ 20.....	145	28
„ 22.....	132	14	„ 27.....	123	22
„ 29.....	98	9	Dec. 4.....	160	45
June 5.....	112	16	„ 11.....	137	38
„ 12.....	112	19	„ 18.....	132	28
„ 19.....	119	15	„ 25.....	135	38
„ 26.....	126	24			

Christened	6614
Buried.....	7920
Plague Burials	2124

D.

Collection of the Yearly Bills of Mortality for London, 1606-7.

1606-7.	Burials.	Plague Burials.	1606-7.	Burials.	Plague Burials.
Jan. 1.....	150	38	July 2.....	112	27
„ 8.....	115	26	„ 9.....	117	33
„ 15.....	121	16	„ 16.....	154	37
„ 22.....	106	14	„ 23.....	152	51
„ 29.....	134	28	„ 30.....	156	43
Feb. 5.....	158	33	Aug. 6.....	187	77
„ 12.....	147	20	„ 13.....	172	69
„ 19.....	149	17	„ 20.....	189	76
„ 26.....	120	14	„ 27.....	175	71
March 5.....	127	20	Sept. 3.....	232	105
„ 12.....	130	30	„ 10.....	243	121
„ 19.....	138	33	„ 17.....	264	124
„ 26.....	124	22	„ 24.....	302	177
April 2.....	123	13	Oct. 1.....	283	150
„ 9.....	138	23	„ 8.....	230	113
„ 16.....	146	27	„ 15.....	223	110
„ 23.....	133	26	„ 22.....	215	82
„ 30.....	125	43	„ 29.....	198	68
May 7.....	94	17	Nov. 5.....	196	66
„ 14.....	128	15	„ 12.....	186	55
„ 21.....	126	25	„ 19.....	148	46
„ 28.....	116	13	„ 26.....	130	21
June 4.....	100	11	Dec. 3.....	126	19
„ 11.....	90	10	„ 10.....	122	28
„ 18.....	86	14	„ 17.....	131	7
„ 25.....	126	21	„ 24.....	129	9

Christened 6,582
Buried 8,022
Plague Burials 2,352

E.

Collection of the Yearly Bills of Mortality for London, 1624-5.

1624-5.	Burials.	Plague Burials.	1624-5.	Burials.	Plague Burials.
Dec. 23.....	183	0	June 23.....	640	239
„ 30.....	211	0	„ 30.....	942	390
Jan. 6.....	220	1	July 7.....	1222	593
„ 13.....	196	1	„ 14.....	1741	1004
„ 20.....	240	0	„ 21.....	2850	1819
„ 27.....	226	0	„ 28.....	3583	2471
Feb. 3.....	174	3	Aug. 4.....	4517	3659
„ 10.....	204	5	„ 11.....	4855	4115
„ 17.....	211	3	„ 18.....	5205	4463
„ 24.....	252	1	„ 25.....	4841	4218
Mar. 3.....	207	0	Sept. 1.....	3897	3344
„ 10.....	210	0	„ 8.....	3157	2550
„ 17.....	262	4	„ 15.....	2148	1672
„ 24.....	226	8	„ 22.....	1994	1551
„ 31.....	243	11	„ 29.....	1236	852
April 7.....	239	10	Oct. 6.....	838	538
„ 14.....	256	24	„ 13.....	815	511
„ 21.....	230	25	„ 20.....	651	331
„ 28.....	305	26	„ 27.....	375	134
May 5.....	292	30	Nov. 3.....	357	89
„ 12.....	332	45	„ 10.....	319	92
„ 19.....	379	71	„ 17.....	274	48
„ 26.....	401	78	„ 24.....	231	27
June 2.....	395	69	Dec. 1.....	190	15
„ 9.....	434	91	„ 8.....	181	15
„ 16.....	510	165	„ 15.....	168	6

Christened 6,983
Buried 54,262
Plague Burials 35,417

F.

Collection of the Yearly Bills of Mortality for London, 1664-5.

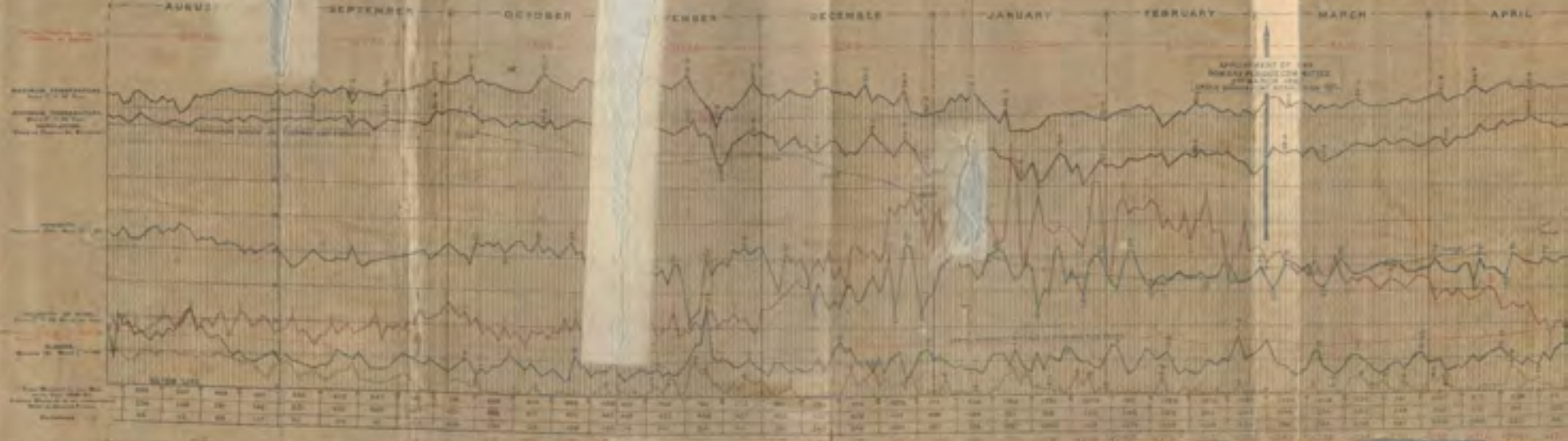
1664-5.	Burials.	Plague Burials.	1664-6.	Burials.	Plague Burials.
Dec. 27.....	291	1	June 27.....	684	267
Jan. 3.....	349	0	July 4.....	1006	470
„ 10.....	394	0	„ 11.....	1268	725
„ 17.....	415	0	„ 18.....	1761	1089
„ 24.....	474	0	„ 25.....	2785	1843
„ 31.....	409	0	Aug. 1.....	3014	2010
Feb. 7.....	393	0	„ 8.....	4030	2817
„ 14.....	462	1	„ 15.....	5319	3880
„ 21.....	393	0	„ 22.....	5568	4237
„ 28.....	396	0	„ 29.....	7496	6102
March 7.....	441	0	Sept. 5.....	8252	6988
„ 14.....	433	0	„ 12.....	7690	6544
„ 21.....	363	0	„ 19.....	8297	7165
„ 28.....	353	0	„ 26.....	6460	5533
April 4.....	344	0	Oct. 3.....	5720	4929
„ 11.....	382	0	„ 10.....	5068	4327
„ 18.....	344	0	„ 17.....	3219	2665
„ 25.....	398	2	„ 24.....	1806	1421
May 2.....	388	0	„ 31.....	1388	1031
„ 9.....	347	9	Nov. 7.....	1787	1414
„ 16.....	353	3	„ 14.....	1359	1050
„ 23.....	385	14	„ 21.....	905	652
„ 30.....	400	17	„ 28.....	544	333
June 6.....	405	43	Dec. 5.....	428	210
„ 13.....	558	112	„ 12.....	442	243
„ 20.....	615	168	„ 19.....	525	281

Christened 9,967
Buried 97,306
Plague Burials..... 68,596

BOMBAY PLAGUE VISITATION OF 1896-97.

SHOWING MORTALITY AGAINST TEMPERATURE, HUMIDITY, WIND, VELOCITY, AND CLOUD.

ADAPTED FROM A DIAGRAM PREPARED BY GENERAL GATACRE'S COMMITTEE.



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